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Cellulose—Some Relations Between Its Moisture Regain and Reactivity

By A. J. HALL, B.Sc., F.I.C., F.T.I.

CELLULOSE in the form of film or fiber must be regarded as a colloid and in common with substances of this type has a reactivity largely determined by its state of dispersion, or expressed otherwise, its reaction to external influences is dependent on its internal reactive surface. The extent of this surface can be approximately measured by the moisture regain or the water absorbent properties of the cellulose and this thus becomes a useful means for ascertaining the reactivity of a cellulose fiber such as cotton or viscose and cuprammonium rayon.

The moisture regain of cotton is of course intimately connected with the surrounding humidity of the air; the greater this humidity, the greater the moisture absorbed. Thus ordinary kier-boiled cotton in an atmosphere of relative humidity of 15% absorbs about 3% of moisture whereas the same cotton absorbs 20% of moisture when the air has a relative humidity of 95%; the term relative humidity expresses the degree of saturation of the air with moisture. Under ordinary conditions air has a relative humidity of about 60-80%, and cellulose materials casually exposed absorb moisture proportional to this. So that in comparing the reactivities of different celluloses by means of their moisture regains the conclusions drawn will only be strictly accurate if these moisture regains refer to the same conditions of humidity of the surrounding air. Many observations concerning the moisture absorption of cellulose fibers to be found in the literature can unfortunately only be taken as approximate because they were determined under ordinary instead of accurately defined conditions of humidity, but, nevertheless, they are valuable as indicating the general properties of the cellulose.

One of the most important properties of a cellulosic fiber is its behavior towards dyestuffs. How is this property connected with moisture regain?

In dealing with this question it is necessary to draw attention to the difference in dyeing properties of mercerized and non-mercerized cotton. Mercer early recognized that by treatment with caustic soda, cotton gained an increased affinity for direct dyes while later the further fact emerged that the mercerized cotton had a greater affinity for moisture; both these facts must further be correlated with the well known fact that in mercerization the cellulose of the cotton swells considerably. Now it is generally found that the greater the swelling of the cotton during mercerization the greater the shrinkage in length of the fibers or yarn, so that from Fig. 1, which shows the relations between the concentration of caustic soda used

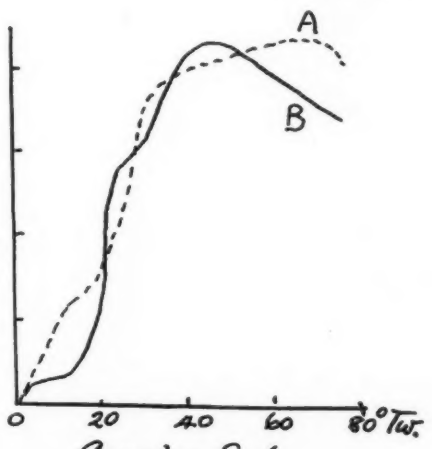

Fig. 1.
A=*Dye Absorption*
B=*Shrinkage*

in mercerizing and the resulting increase of affinity for Benzopurpurine 4B and shrinkage in length as determined by J. Huebner and W. J. Pope (J. Soc. Chem. Ind., 1904, 23, 404), it may be concluded that with mercerization, increased affinity for direct dyes, moisture, and swelling follow similarly.

Further evidence on this point is collected in Tables 1 and 2, and this is shown graphically in relation to some observations of Coward and Spencer (J. Text. Inst., 1923, 14, 41). Table 1 shows how the affinity of cotton mercerized with caustic soda increases with the concentration of alkali employed, these results being obtained by E. Knecht (J. Soc. Dyers, and Col., 1908, 24, 67 and 107), using Egyptian cotton yarn and carrying out the alkali-treatment while under tension.

TABLE 1

Concentration of mercerizing solution (Caustic soda)	Benzopurpurine 4B absorbed
0 Tw.	1.77 grams
10.4	1.88
19.0	2.49
25.0	2.57
30.4	2.95
35.1	3.02
37.5	3.15
45.0	3.27
50.4	3.38
55.0	3.50
60.0	3.56
64.2	3.60
69.4	3.66

In Table 2 is shown the hygroscopicity values of cotton mercerized with various concentrations of caustic soda as found by S. H. Higgins (J. Soc. Chem. Ind., 1909, 28, 188).

TABLE 2

Concentration of mercerizing solution (Caustic soda)	Moisture regain
0 Tw.	6.2%
10	6.37
20	6.68
30	8.40
40	9.41
50	9.43
60	9.57
70	9.69

Similar results were obtained by C. G. Schwalbe (Z. Angew. Chem., 1909, 22, 197) as shown in Table 3.

TABLE 3

Concentration of mercerizing liquor (Caustic soda)	Moisture regain
0%	6.1%
8	7.7
16	10.7
24	11.3
40	12.1

In the experiments of Coward and Spencer (J. Text. Inst., 1923, 14, 41) loose cotton was mercerized with caustic soda solutions of increasing concentration, then washed, soured, washed, and while wet, thoroughly centrifuged to remove water merely adhering to the surface of the fibers; the weight of the centrifuged cotton then measured the amount of water retained.

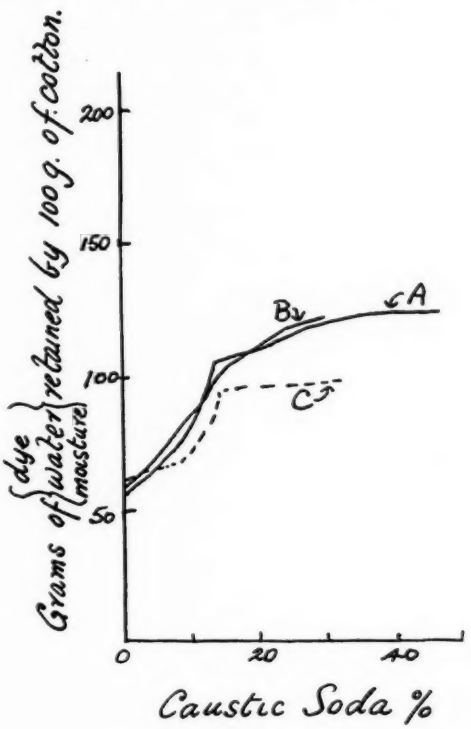

Fig. 2.
A=Water Retained (Coward and Spencer)
B=Dye Absorption (Knecht)
C=Moisture Regain (Higgins)

The results embodied in Fig. 2 show how closely is related the affinity of cotton for a direct dye with its swollen condition as measured by its absorption of moisture from the surrounding air, and also with its retention of water while in a wet state. It is quite reasonable to assume that either of these three properties can be used for measuring the reactive surface of the cotton cellulose.

It has been found that mercerization also increases the absorption of iodine by cotton and this absorption is also in agreement with the moisture regain as seen from the following results of Higgins (J. Soc. Chem. Ind., 1909, 28, 188).

TABLE 4

Cotton	Absorption of Iodine. A %	Moisture B %	Ratio B/A
Ordinary unbleached cotton	0.30	6.52	21.73
Ordinary bleached cotton	0.2296	6.25	21.59
Mercerized without tension (unbleached)	0.4622	...	....
Mercerized without tension (bleached)	0.4216	9.33	20.19
Mercerized with tension (unbleached)	0.4136	9.12	21.63

Mercerized with tension (bleached)	0.3556	8.05	22.63

The ratio of the iodine and moisture absorptions shown above is remarkably constant.

So far as a search of the literature can reveal there is no evidence but that direct dyes are always more strongly absorbed by mercerized than by non-mercerized cotton. But mercerized cotton does not show an increased affinity for basic dyes. This fact supports the view that the process of mercerization is merely a means for increasing the reactive surface of a cellulose without affecting the chemical properties.

Now it is well known that if during mercerization the cotton is subjected to stretching, then the dyeing power of the resulting cotton is not increased to so great an extent as would be the case without stretching. It would thus be reasonable to anticipate that the moisture absorption of cotton mercerized under tension would be proportionally less; this is in fact actually found to be the case. The magnitude of the effect of stretching on the dye absorption is shown by the following results obtained by Knecht (J. Soc. Dyers and Col., 1908, 24. 67 and 107):

TABLE 5

Absorption of Benzopurpurine 4B

Cotton	Unbleached	Bleached
Non-mercerized	1.55%	1.50%
Mercerized with tension	2.90	2.86
Mercerized without tension	3.39	3.54

A. R. Urquhart (Shirley Inst. Mem., 1926, 5, 304) has accurately measured the absorptions of moisture by cottons mercerized with and without tension, and some of his results are indicated in the following Table 6. It will be noticed that the absorptions are highest after mercerization with caustic soda of 25 per cent.

TABLE 6

Grams of moisture absorbed by 1 gram of dry cotton

Relative humidity	Mercerized without tension				Mercerized with tension		
	Concentrations of mercerizing liquors						
	0%	15%	24.9%	35.7%	15%	24.9%	35.7%
18.6%	.0293	.0395	.0428	.0361	.0325	.0365	.0340
39.2	.0468	.0641	.0674	.0577	.0519	.0585	.0554
59.1	.0687	.0943	.0993	.0842	.0757	.0840	.0796
78.3	.0950	.1296	.1371	.1163	.1046	.1147	.1091
88.9	.1350	.1867	.1966	.1671	.1522	.1651	.1549
96.0	.1854	.2723	.2907	.2360	.2155	.2370	.2144

The amount of stretching required to produce such definite differences in the moisture absorption and dye affinity of mercerized cotton is not very large. This is evident from the curves shown in Fig. 3a and 3b for cotton mercerized with 15 per cent and 25 per cent caustic soda.

After swelling with a caustic alkali it makes a considerable difference to the properties of the cellulose according to the manner in which the wet cotton is treated. Of particular importance is the manner of drying—whether the drying is carried out slowly at a low temerature, or whether it is rapidly dried at boiling temperature. Knecht has recorded the effect of drying on the dyeing properties of mercerized cotton and these are indicated below in Table 7.

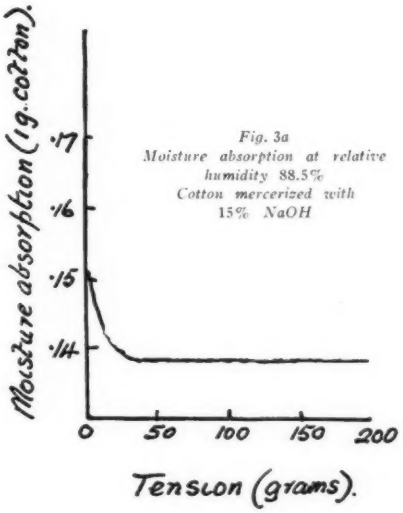

Fig. 3a
Moisture absorption at relative humidity 88.5% Cotton mercerized with 15% NaOH

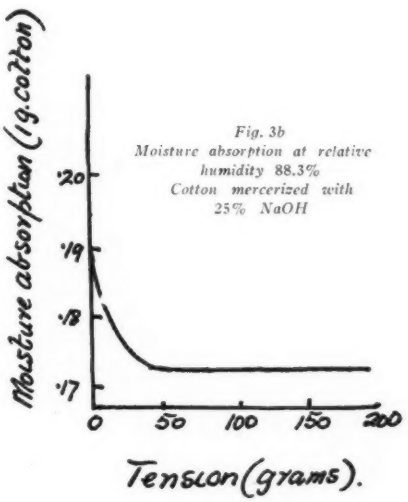

Fig. 3b
Moisture absorption at relative humidity 88.3% Cotton mercerized with 25% NaOH

TABLE 7

Cotton	Absorptions of Benzopurpurine 4B	Chrysophenine
Not mercerized	1.77%	0.58%
Mercerized and dyed before drying	3.24	0.96
Mercerized and air dried before dyeing	3.03	0.92
Mercerized and dried at 110°C. before dyeing	2.51	0.84

As yet no accurate series of results have been obtained showing the corresponding effects of high temperature drying on the *moisture absorption* of mercerized cotton. But it has been observed that the drying of ordinary cotton reduces its affinity for direct dyes and it therefore appears most likely that the rapid drying of mercerized cotton will largely affect its absorption of moisture. This is a subject which awaits investigation.

Summarizing the evidence given above it becomes quite evident that the characteristic result of swelling cotton by the action of caustic alkalies is that of increasing the affinity of the cotton for both moisture and direct dyes. It would, therefore, be anticipated that a similar result would occur with a cellulose artificial silk. This however is not the case. In some recent investigations, A. J. Hall (J. Soc. Dyers and Col., 1929, 45, 98 and 171) has determined the moisture regain and the dye affinity of viscose silk after treatment with caustic soda solutions such that the silk swelled considerably. In most cases the swelled silk showed a marked increase of affinity for direct dyes but at the same time its moisture regain remained almost unchanged. Some of the results obtained are given below:

TABLE 8

Concentration of alkali	Moisture regain
0%	11.6%
1	11.2
2	10.2
3	11.3
4	10.4
5	11.4
6	10.6
7	10.1
8	10.5

These results were obtained by drying in a room under ordinary conditions of humidity so that the moisture regains are not strictly accurate. Nevertheless, they clearly indicate that the silk gained no appreciable increased affinity for moisture. It would therefore appear that it is not possible to increase the affinity of cellulose for moisture beyond a certain limit. Since ordinary viscose silk and fully mercerized cotton have about the same normal moisture regain of 11-12 per cent it is probable that this amount is the limit and that ordinary viscose silk has reached this limit because of the alkaline swelling processes involved in the silk manufacturing processes.

The reactivity of cotton can be measured in other ways besides the method involving its affinity for direct dyes. Among these are methods depending on the changes produced in cellulose by the action of acids and oxidizing agents these changes being measured by a charge of Copper Number. Thus it would be anticipated that a cellulose swelled so as to possess an increased reactive surface would be more rapidly degraded than an ordinary untreated cellulose when boiled with dilute mineral acids. This was shown some years ago by C. G. Schwalbe (Die Chemie der Zellulose) who boiled ordinary cotton, cottons mercerized with various concentrations of caustic soda, and various cellulose artificial silks with 5 per cent sulphuric acid; the increased Copper Numbers thus produced in these celluloses are shown below:

TABLE 9

Cellulose	Moisture absorption	Copper Numbers Before hydrolysis	After hydrolysis	Difference
Cotton	6.1%	1.1%	3.3%	2.2%
Cotton mercerized with 8% NaOH	7.7	0.9	3.2	2.3
Cotton mercerized with 16% NaOH	10.7	1.3	5.0	3.7
Cotton mercerized with 24% NaOH	11.3	1.2	6.1	4.9
Cotton mercerized with 40% NaOH	12.1	1.9	6.6	4.7
Glanzstoff silk	9.8	1.5	12.8	11.3
Viscose silk A	10.7	1.9	14.0	12.1
Viscose silk B	10.2	3.0	14.5	11.5
Viscose silk C	11.0	2.9	16.6	13.7
Nitrocellulose silk	11.4	4.1	17.7	13.6

The above results further show that there is a parallelism between moisture absorption and the reactivity of cellulose. Birtwell, Geake, and Ridge (J. Text. Inst., 1930, 21, 85) have since suggested that it would be better to measure the reactivity of a cellulose by means of its increased Copper Number as produced by oxidation with an alkaline hypobromite solution. It is found that a normal bleached cotton has a Copper Number of 1.5, and the ratio of the Copper Number of a swelled cotton to 1.5 (called the reactivity ratio) is considered to be a measure of its reactivity. This method has several advantages over the Schwalbe hydrolysis method and among these it

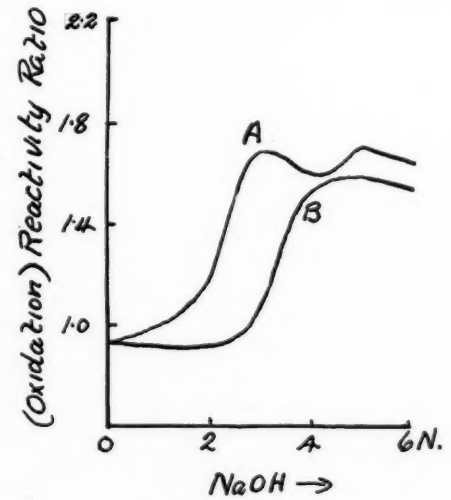

Fig. 3.
A=*Mercerized at*—10° C.
B=*Mercerized at*+18° C.

is more sensitive to small changes of reactivity. An interesting point is that treatments with caustic soda and potash produce very similar changes in the moisture

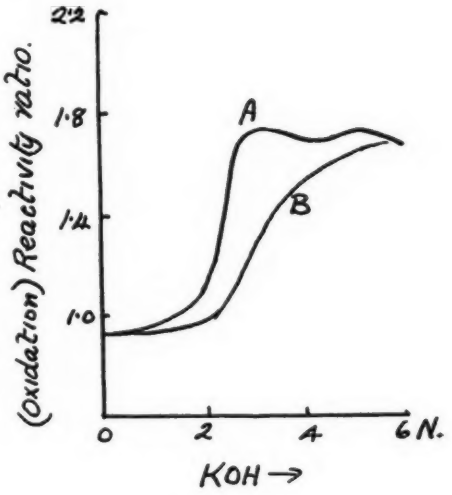

Fig. 5.
A=*Mercerized at*—10° C.
B=*Mercerized at*+18° C.

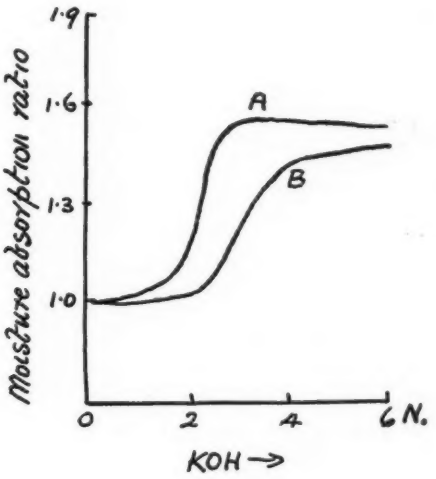

Fig. 6.
A=*Mercerized at*—10° C.
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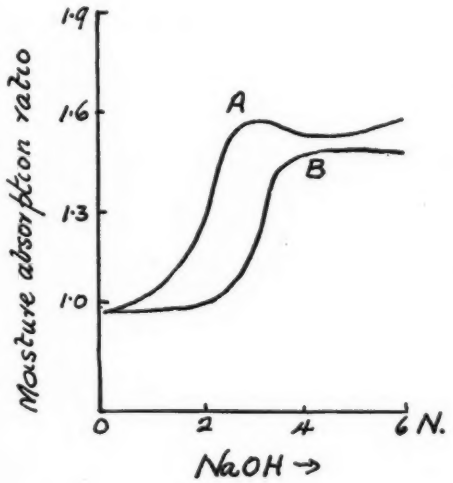

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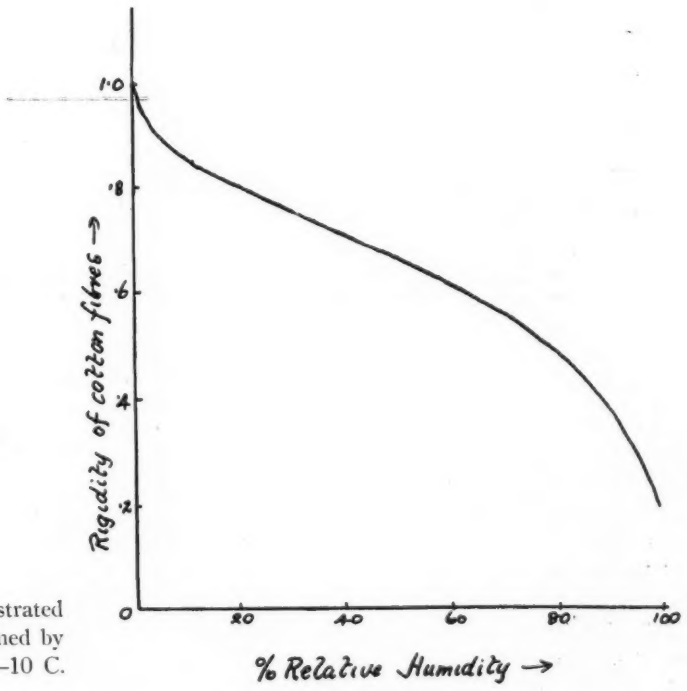


Fig. 7.

absorption and reactivity ratios of cotton; this is illustrated in Figs. 4, 5, 6 and 7 which show the results obtained by effecting the alkali-treatment at temperatures of —10 C. and + 18 C.

The moisture absorption of cellulose is also of importance as regards its physical properties. Thus cotton fabrics are much more difficult to tear when wet, while on the other hand, viscose and other artificial silks lose about 50 per cent of their tensile strength when immersed in water. In particular, measurements on the rigidity of cotton (Peirce; J. Text. Inst., 1924, 15, 505) have shown that this rigidity steadily decreases as the cotton is surrounded by an atmosphere of increasing humidity. This indicates that cotton fibers become more plastic as they absorb increasing amounts of moisture. The relation between rigidity and humidity is shown in Fig. 8.

Finally it must be mentioned that the treatment of cellulose with caustic alkalies is of great importance in the manufacture of viscose silk. This treatment, which results in the formation of alkali-cellulose which is then suitable for conversion into cellulose xanthogenate, is probably something more than a chemical reaction between cellulose and caustic soda; it is very likely that the fact cellulose (because of the alkali treatment) gains an increased absorptive power for moisture has a definite influence in the formation of the viscose solution. The solution of any cellulose derivative in water or dilute alkali appears to consist, in its first stage, of an attraction of the aqueous liquor to the cellulose. Hence if the cellulose is given

an increased affinity for moisture then this process of solution is likely to be accelerated or made more easy. T. Lieser (Cellulosechemie, 1929, 10, 21) has utilized this fact to distinguish between different types of cellulose. His method consists of treating the cellulose with caustic soda of increasing concentration and determining the amount of the treated cellulose which remains insoluble when further treated so as to form cellulose xanthogenate. The relation between concentration of alkali and the amount of resistant cellulose can then be expressed as a curve which is a characteristic of the particular cellulose employed. It is observed that cotton requires a higher concentration of alkali than does wood cellulose or viscose silk to render it soluble. Characteristic curves for three types of cellulose are shown in Fig. 9.

It would thus appear that research on the behavior of cellulose towards moisture is of the greatest importance since the results should throw much light on the properties of all cellulosic fibers as regards their plasticity, tensile strength, dyeing properties, and resistance or susceptibility to all kinds of chemical influences.

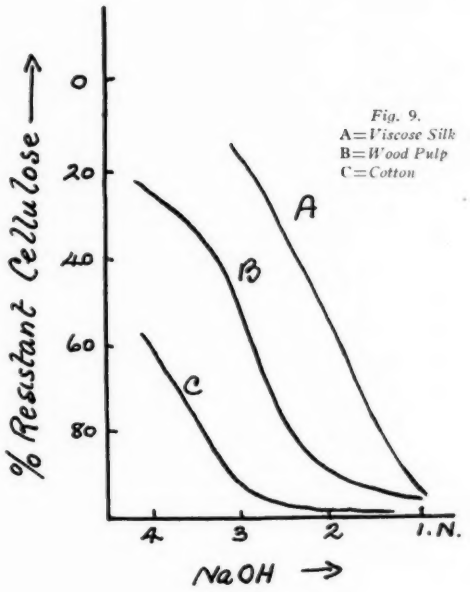


Fig. 9.
A=*Viscose Silk*
B=*Wood Pulp*
C=*Cotton*

Recent Improvements in Machinery for Bleaching with Hydrogen Peroxide

By RAFFAELE SANSONE

RECENT investigations have confirmed that the bleaching action of hydrogen peroxide on rayon and silk goods can be increased by causing the baths of treatment to follow simultaneously different directions, and more especially a horizontal and a vertical direction. In utilizing the new principle for practical purposes unexpected difficulties were encountered, caused by the greater contact with the metallic sides of the bleaching vessels, and with the circulation tubing and centrifugal pumps, a violent decomposition of the product often taking place with a strong development of active oxygen, that went lost in this case. The inconvenience was only insufficiently reduced by using the said vessels, the tubing and the pumps of metals on which hydrogen peroxide acted less. By covering these with a suitable internal protective covering more satisfactory results were however possible.

In a machine, recently patented, cylindrical iron vats with a cement interior were used, the catalytic action of which was quite small on all dilute solutions producing active oxygen. Here the special form of double circulation, enforced in the bath of treatment, was arranged by establishing in the center of the vats a tube with holes on all sides, through which the bleaching liquid could be delivered in the material, while a second stream of bleaching fluid, having a somewhat weaker speed, was brought to it from above, and made its way out through the bottom, for being rebrought into circulation, continuing in this way to the end of the bleaching operations.

Bleaching Loose Silk and Silk Yarn

A machine is shown in Fig. 1, where the above double circulation principle has been adopted under conditions that loose waste silk, loose waste rayon, or silk or rayon yarn, can be brought to a pure permanent white, without suffering any mishandling, or any irregularity resulting.

This consists of a high cylindrical iron vat or trough T, the interior of which is lined with cement, or hardened india rubber, brought in all cases to a smooth uniform surface. The capacity of trough T is regulated with the weight of material it is wished to treat per time. The latter would never however

surpass certain limits, as it is better to subdivide the treatment of the larger lots over several apparatus, rather than to treat them in one time. On the lower portion of the vat is placed a glass diaphragm D of a certain thickness, furnished with many perforations, and held at a small height from the bottom through a slight projection in the interior. In the center of diaphragm D is fixed a small hardened india rubber cone, fitted at the top of an iron tube I, the interior and exterior of which is supplied with a sufficiently thick layer of india rubber, for avoiding all contact with the bath of treatment, while protecting at the same time against the formation of rust. Tube I is furnished with tap f, which contains on the other side tube H, that ends in the upper part of centrifugal pump P, and forms a T with the upper tube F, also furnished with a tap, and with a further tube E

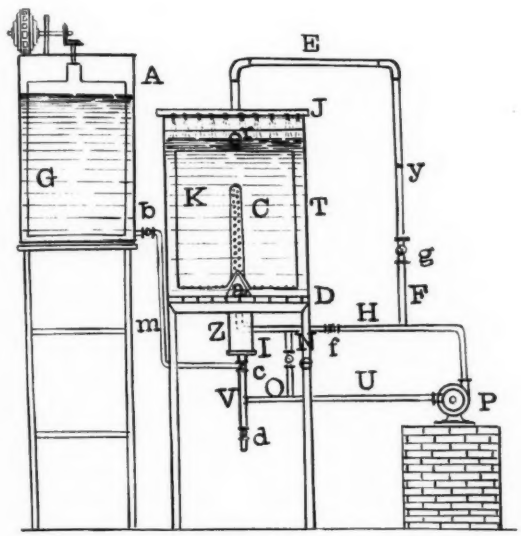


Fig. 1

for regulating, stopping or initiating the passage of the baths of treatment to tube E. This tube distributes the baths on the goods through cover J, the lower face of which is perforated. The upper portion of tube E can be made to turn on the lower portion through the assistance of a sliding joint. In this way cover J can be removed from trough T with the greatest facility whenever it is necessary to have access to its interior.

To the bottom of trough T is fixed a broad iron tube Z, thickly covered in its interior with cement or hardened india rubber, and leading to tap c, that receives by tube m and tap b the hydrogen peroxide bath from the upper iron, india rubber or cement covered, cistern A. Here all the baths are prepared by making use of agitator G, that is turned through toothed wheels and a small electric motor. Cistern A is fixed on a light iron stand, having a small platform for the operatives, long strengthened iron legs, and a light iron stairs easily mounted whenever necessary.

Below tap c is fitted the T-tube V, containing at its bottom the discharge tap d, and ending in tube U, that leads to the bottom of centrifugal pump P. This is of perfectioned construction and is driven by a second electric motor, being placed at a small height from the flooring of the works on a white brick platform. Between tube U and tube H are arranged the short tubes O and N and tap e, which last is closed with tap f when it is wished to only enter the bleaching bath before placing in movement pump P. In the interior of trough T can be entered or taken out, with the greatest facility, through the assistance of the upper ring r, and a hand-crane running on an overhead rail, a strong cylindrical cage K, that is of a special non-metallic material. This is supplied with a flat perforated bottom, having in the center a cone that fits exactly above cone a, and has just above the strongly perforated tube C.

Work on the Machine

For working the above machine, the operative in charge, after having rinsed from a preceding bleaching operation with abundance of clean cold running water, moves away cover J by turning this on the lower part of tube E. When the upper part of vat T has thus been opened, he raises cage K through the assistance of the overhead crane, and pulls it before the machine where the loose silk, loose rayon, or silk or rayon yarn, has been cleansed through boiling with a soap bath, submitting to washing with cold water. Here the batch of material to be further treated is entered as loosely as possible in the cage, and this last is rebrought to the bleaching plant, where in the meanwhile the bath of hydrogen peroxide has been prepared in the upper cistern A. Cage K is then entered in trough T, and cover J is turned for coming just above; the former thus remains nearly hermetically closed.

At this point taps e and f are closed, and taps c and b opened, for causing the bath of hydrogen peroxide to enter by its own weight in contact with the material. When in this way trough T has been sufficiently filled, tap e is closed, and taps f and g are opened, placing in movement pump P. The bleaching bath is aspired in this way through tubes V and U and a portion of it is delivered into tube H, tap f, tube I, cone a and the central perforated tube C, coming thus to pass out all round across the goods. While this is taking place another portion of the bath is raised in tubes F and E and is thrown on the goods in cage K in the form of a compact shower. Through the arrangement is produced in vat T a continual delivery of liquor, that goes forward horizontally and vertically, following also other directions, and is obliged to treat the innermost cells of the material.

Through the arrangement a full white is reached

more rapidly than with the ordinary bleaching processes, and the bath of treatment can soon be run off into a lower cement collection cistern by stopping pump P, closing tap f and opening tap d, from which it can be raised again, if necessary, to cistern A, and used for preparing a second decolorizing bath through the addition of new hydrogen peroxide.

Advantage of the Machine

The above machine has several important advantages, some of which can be indicated as follows:

1. Cage K can be charged with a good load of loose silk or rayon, or of rayon or silk yarn, and this comes to be equally bleached all through as a consequence of the very intensive chemical and mechanical action enforced with the hydrogen peroxide bath.

2. By obliging the bath of treatment to traverse in two directions, this is obliged to mix continually together while passing in contact with the material, creating a more easy liberation of active oxygen than would otherwise be the case.

3. Through the employment of the crane run on the overhead rail, the material can be charged in a dry condition in the grey room, or in a wet condition in the boiling off or cleansing department, or wherever else may be necessary, and if two cages are at disposal one of these can be charged while the contents of the other is being treated.

4. Through covering all tubing and trough T inside and outside with a thick layer of hard india rubber or cement, and using the most suitable material for pump P, there is no danger that any metallic portion should come in contact with the hydrogen peroxide bath, bringing to an unnecessarily rapid liberation of its active oxygen.

5. The rinsing of the silk and rayon material comes to be conducted with the same energy as the decoloration process, avoiding the necessity of a supplementary washing on the hydroextractors.

6. If a hydroextractor is available of sufficient size cage K can be lowered into it liberating the greater portion of the water through centrifugal force, and transporting later the loose material or yarn to the drying department.

7. Through the special arrangements on the machine old baths of hydrogen peroxide can be employed over and over again, reducing the cost of the bleaching, etc., etc.

Bleaching Silk or Rayon Fabrics

There is great difficulty in applying the above double circulation principle to the bleaching of silk or rayon fabrics, owing to the much larger amount of bleaching bath required in this instance. A machine where the treatment could be conducted to advantage is constructed on the principle shown in Fig. 2.

This contains a long, narrow, iron vat V, divided into six compartments A, B, C, D, E, F, by partition plates of the same metal. All compartments are lined with a thick coating of cement or india rubber, and on their bottom is fitted a thick glass plate with many perforations at regulated intervals. Vat V is placed at a small height from the pavement on several solid iron legs. At its beginning is the small wagon J and a pair of entrance frames, that liberate from all plaits and folds. After this the silk or rayon material descends in the first compartment, where it is lead up and down several times on glass binding rollers, passing between the nip of india rubber squeezing rollers a, and from here to the successive compartments B, C, D, E, F, on other guiding rollers and through the other squeezing rollers b, c, d, e, f, making its way after compartment F to the pair of frames H and to plaiter P for descending on a second small wagon L, ready for bringing to the rinsing machine, where the hydrogen peroxide left in the material is eliminated, and the necessary soaping and bluing operations are conducted, that prepare the goods for the market.

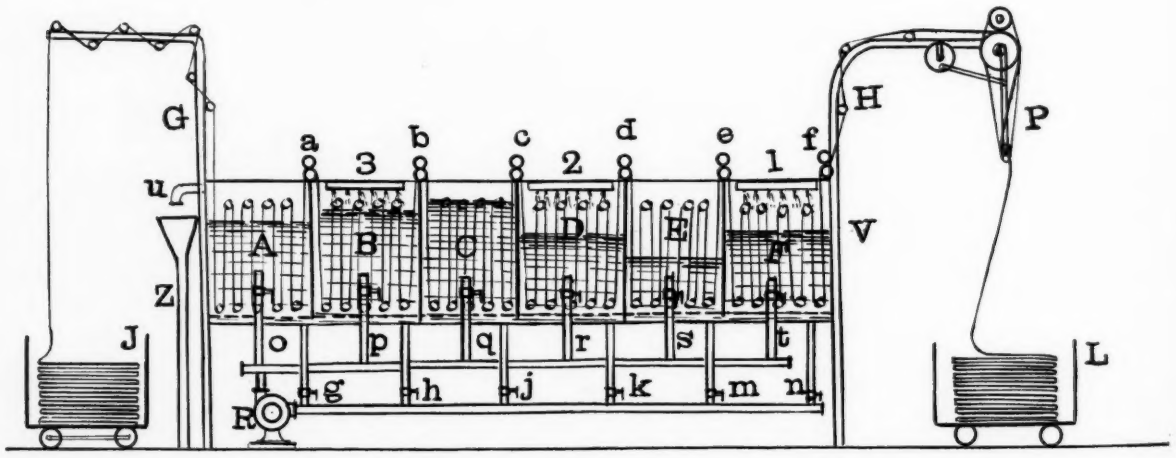


Fig. 2

The bleaching bath is prepared in this instance in a large iron cistern lined with cement, and is caused to enter from one of the long sides of vat V by means of the long tube N and the short tubes and taps o, p, q, r, s, t. Tube N enters at the same time the bleaching fluid simultaneously in compartments F, D and B from upper perforated glass distribution trays 1, 2, 3. From compartments F, D, B, the bleaching baths make their way, by a lower opening, to compartments E, C, A. In the three cases the excess of bath makes its way to tube M, through which it is aspired by pump R and replaced continually in circulation by entering directly in tube N. Tube M also serves for aspiring the bleaching bath through the shorter tubes g, h, j, k, m, n, that are placed at the back of vat V. All tubing is of iron, and is lined in the inside and covered over on the outside with a thick hardened india rubber or cement covering, pump R being of a special non-metallic composition that resists perfectly the action of the strong oxidizing baths.

For guaranteeing a constant strength from the beginning to the end in the bath employed for the bleaching of the silk or rayon material a small supplementary quantity of this is entered continually in the last compartment F, using a special tube and tap, which serves also for the first filling operations. An overflow tube at the beginning at vat V, indicated by u, causes all excess of bath to fall in the funnel tube Z, that leads to a lower cement collection cistern, where the old baths can be neutralized several times after the necessary strengthening. The machine is driven by a strong electric motor, that moves all binding rollers and the squeezing cylinders through pinion wheels, a long steel shaft with worm gearing, etc. A small disposition is annexed to the electric motor, that allows the operatives to regulate the speed of the cloth being bleached any required number of yards per minute.

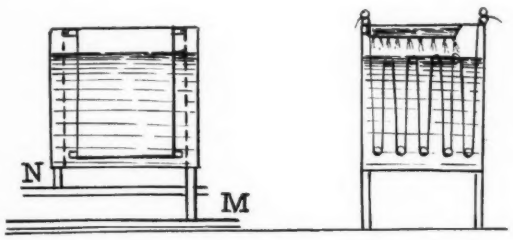


Fig. 3.

Fig. 4.

In Fig. 3 is shown how a portion of the bleaching bath traverses the cloth horizontally, entering at several heights at a time through the long tube N, and making its way out by other perforations on the opposite side of the vat for being aspired by the long tube M and replaced in circulation. In Fig. 4 is indicated how the bath falls vertically on the fabrics while these are moving forward.

Work on the Machine

For working the above machine, the beginning of the first piece of silk or rayon cloth to be decolorized is fixed to a cotton tape run through the whole of vat V, and having its beginning hanging from plaiter P. The speed of the machine is then regulated, arranging the most suitable number of yards to enter per minute, and are varied in accordance with the nature of the cloth to be bleached.

While this is taking place, another workman prepares in the large cement covered cistern already indicated, the quantity of hydrogen peroxide bath required for filling all compartments in vat V, and keeping back what is necessary for continually replacing the active chlorine that is lost during the passage of the goods. After this the operative opens the tap at the bottom of the said cistern for running the bath into vat V, reducing the speed of entrance of this last when liquid initiates its passage through overflow tube u and descends into funnel tube Z.

The machine is then placed in movement for treating the silk or rayon fabric, that thus moves forward at the regulated speed through the six different baths of treatment, being of a full white by the time it reaches the last, and is pressed between cylinders f, making its way down to the small collection wagon, forming here piece after piece ready for carrying to the rinsing machine. In the meanwhile the double circulation of the bleaching bath continues, treating in a different way the portions of the cloth that receive the bath across the width, than those that receive it down the length; a third kind of treatment taking place during the continual mixtures of the two kinds of flows of bleaching fluid. As the bath passes continually through vat V, the chemist takes from time to time a sample for proofing its contents in active oxygen, and should this be found too weak the speed of treatment is reduced for keeping the material longer in contact. If necessary, the amount of strengthening bath entering is increased, taking other samples after this for controlling if matters have been put right.

While the control of the bath is being conducted, a counter control is made on the bleached cloth coming out of the apparatus. This is conducted by comparing a small wet sample of silk or rayon cloth, of the same nature as that being treated, with that coming down from plaiter P. In this way even a slight difference in the purity of the white can be detected in time for avoiding damage on a strong quantity of the material and can be put right in time.

Advantages of the Machine

The machine has several important advantages. A portion of these can be indicated as follows:

1. The fibers in the silk or rayon fabrics receive the bleaching liquid from different directions, and are obliged to remain continually under its action, becom-

ing white much sooner than is the case on many of the ordinary machines.

2. Through the continual movement of the hydrogen peroxide bath, and the continual contact of the different molecules in the same, the development of active oxygen is not only greater, but is compelled to take place equally in all portions of the bath simultaneously.

3. Every metallic portion is covered through a thick layer of cement or hardened india rubber, and however rapid may be the passage of the bleaching baths, there is absolutely no possibility of contact with the latter, and all danger of explosions or excessive development of active oxygen is therefore avoided.

4. Through the possibility of regulating to the yard the speed of passage of the goods, the treatment can be conducted very rapidly with the thinner, unless the baths be used much weaker from the start, while with the thicker fabrics they can be left the necessary amount of time in the baths for obtaining the intensity of white desired, etc.

Achema VI Exhibition of Chemical Apparatus

THE Achema VI, the great international exhibition of chemical apparatus, was held this year in Frankfort o/M. The spectacle, contained in four great halls and covering an area of four acres, was an impressive picture of the enormous progress in this branch of the industry. The Achema was an event which brought out clearly the present state of development of the chemical industry and of the construction of chemical apparatus.

A walk through the Achema made it difficult for one to avoid a feeling of surprise. It was only after an examination of the exhibits of the various scientific and technical bodies that one realized how great has been the development of chemical technology. Of special interest in this connection was the model of Liebig's laboratory in Giessen dating from the year 1842, in which all the details of contemporary methods were represented.

The details of certain pieces of apparatus made a special impression. This was particularly true of the exhibition of measuring instruments, many of which were based on new principles, and many of which were already helping to fulfill a demand for cheaper and more rapid working methods. A large percentage of these were automatic. Other pieces of apparatus of special interest were: balances that would measure the weight of a dust particle, X-ray apparatus which showed the mysteries of crystal structure, and a spray dryer which could convert milk instantaneously into a fine powder without altering the properties of its constituents.

There were also exhibits of industrial value, such as: an industrial scale condensing plant of fused quartz, artificial silk manufacturing machinery, stainless steel machinery, high pressure boilers, and so many other things that even a summary would be a task for specialists.

Book Review

Popular Industrial Chemistry. *James A. Branegan, President, Kali Manufacturing Co., Philadelphia, Pa. pp.* 164. *Price,* $2.50.

There are many small industrial plants distributed throughout the country that cannot afford to employ skilled chemists, although they frequently have a use for chemical knowledge. There is usually present in such works some young man, technically inclined, who can, without any extensive training, make simple tests, that will be sufficiently accurate for control work, identification, and as aids in the location of trouble. It is for such that this book has been written as well as for tanners, dyers, superintendents and foremen who have not had the advantages of a technical education.

Part I, which comprises considerably more than half the book, is devoted to a description of the important chemicals used in the industries.

Part II gives a tabulation of simple qualitative tests for all the common metals and acids.

Part III includes a number of special tests, for the most part quantitative, of such materials as coal, soap, water, lubricating oils, soluble oils and silk weighting.

Part IV presents tables of the elements, comparative Fahrenheit and Centigrade thermometer readings, and specific gravity tables of various chemical solutions.

Part V provides the necessary information for first aid in the case of poisoning.

The book is attractively bound in a flexible leatherette cover of convenient size for laboratory use.

L. A. O.

Oakite Display at Southern Textile Exposition

How quality products are procured by simple changes in wet finishing processes will be shown in Oakite Booths Nos. A-47 and 48 in Textile Hall. Samples that have been processed with Oakite in boil-out, bleach, degumming, dye bath, fulling and soaping operations, will be on display for inspection and direct comparison. Rayon, combinations of rayon and silk, silk, cotton and wool products will be exhibited.

The program for the Ninth Southern Textile Exposition is rapidly assuming definite shape. Mr. W. E. Beattie, formerly president of Victor Monaghan Co. and American Cotton Manufacturers' Association, was elected a member of the Board of Directors of Textile Hall Corporation. Construction of the new annex is nearly completed and improvements and painting are under way in the Main Hall.

On Wednesday, October 22nd, the Textile Section of the American Society of Mechanical Engineers will hold a National Textile Meeting, beginning at nine o'clock in the forenoon and concluding with a banquet in the evening. The Autumn convention of the Southern Textile Association will open on Thursday morning, October 23rd, and continue with a varied and interesting program throughout the day.

The Production of Even Shades on Viscose of Varying Dyeing Properties

COMMERCIAL viscose and other silks belonging to the regenerated cellulose group, viz., nitro and cuprammonium silks, vary considerably in their dyeing properties, and colors, which normally yield level results fail to cover these differences. In hank dyeing, the variations may be seen from hank to hank or perhaps a hank may be partly light and partly dark in shade, each part being in itself level and not patchy as they would be in the case of ordinary unlevel dyeing.

In piece goods, these differences take the form of light and dark "lines" or "bars," along or across the material. As far as piece goods are concerned, these defects may be due to varying tension in the knitting and weaving processes as well as to variations in the fiber itself.

With the increase in the use of these artificial silks, the problem consequent upon their inherent unlevel dyeing property has been added to the existing list of dyers' difficulties. These notes are intended to draw attention to the problem and further to an achievement on the part of the British chemists who have been responsible for the manufacture of Icyl colors and so brought about the level dyeing of unlevel viscose within the bounds of possibility. The problem has been tackled in a wholehearted manner and a patented range of dyestuffs introduced. Before the advent of Icyl colors, direct cotton colors which are simple in their application found general use; a large proportion of these fail to cover the inherent inequalities of viscose, but there are some which are well suited for the work. Until recently there was a notable lack of suitable dyestuffs for the production of blue shades. This gap has now been filled and a fairly comprehensive range is available.

Direct Colors

These colors, although entirely new products, belong as a class to direct colors, are applied in a similar manner, and may be used in combination with them if desired. Best results regarding the covering of the inequalities are obtained by dyeing near the boil with the minimum amount of Glauber's salt or common salt. This refers to both Icyl and Chlorazol colors.

It will be understood that complete exhaustion of the bath is not desirable or to be expected when dyeing under these conditions, but there is ample compensation in the even results obtained by the adoption of this dyeing method.

From a booklet published by the Imperial Chemical Industries, Ltd.

This departure from the usual method of dyeing direct colors renders it advisable not to allow dyed material to lie for any length of time after withdrawal from the dyebath. This is on account of the fact that the dye liquor is not completely exhausted so that if the goods are left, dyeing will still be proceeding with the consequent production of unlevel effects.

Should such a difficulty occur, it may be obviated by entering the material at the maximum temperature and turning off the steam, allowing the dyeing to proceed in the cooling liquor. This may result in slightly less covering of the irregularities, but it will be found a useful compromise.

Applying Icyl Colors

In common with the direct cotton colors, Icyl colors may be applied with the addition of soap or soluble oil to the bath, both these products functioning as levelling and softening agents.

The following are the products of principal interest for application to viscose of irregular dyeing properties:

Icyl Colors.—Icyl Orange GS, Icyl Orange RS, Icyl Brown GS, Icyl Red GS, Icyl Violet BS, Icyl Blue 2RS, Icyl Navy B, Icyl Blue GS, and Icyl Blue Black 6BS.

Chlorazol Colors.—Chlorazol Yellow 6GS, Chrysophenine GS, Chlorazol Orange POS, Chlorazol Fast Red KS, Chlorazol Fast Helio 2RKS, Chlorazol Fast Helio BKS, Chlorazol Diazo Blue 2BS, Chlorazol Black SDS, and Chlorazol Fast Black BKS.

Chlorazol Orange POS is a little inferior to Icyl Orange GS as regards the covering of irregularities, but is of better fastness to light and washing and may in some cases prove to be a useful alternative, as it gives a similar shade.

For the production of full blacks the ordinary direct blacks such as Chlorazol Black ES and LFS are quite suitable. Although these colors do not cover the irregularities in light or medium shades, as full blacks the results are quite good and there is little need to have recourse to other blacks.

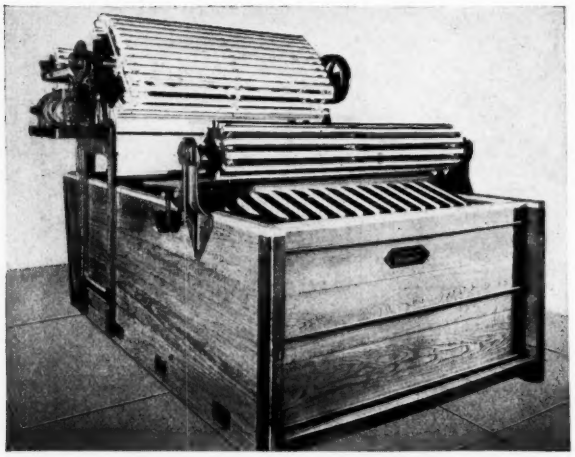
New Machinery

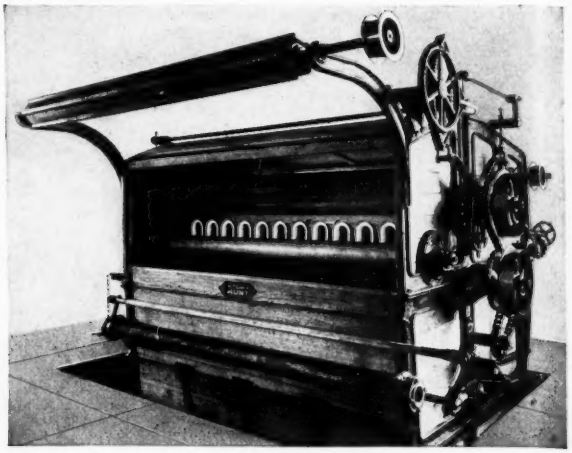
IN view of the great interest shown at the present time in all improvements in machinery design, it is of interest to note four of the new machines that are now being manufactured by the Rodney Hunt Machinery Company. From time to time, other machines of advanced design will be commented on briefly.

Silk Dye Beck

This new Dye Beck was designed particularly for silks and rayons.

It is equipped with anti-friction bearings encased in a water and grease-proof housing. The motor drive



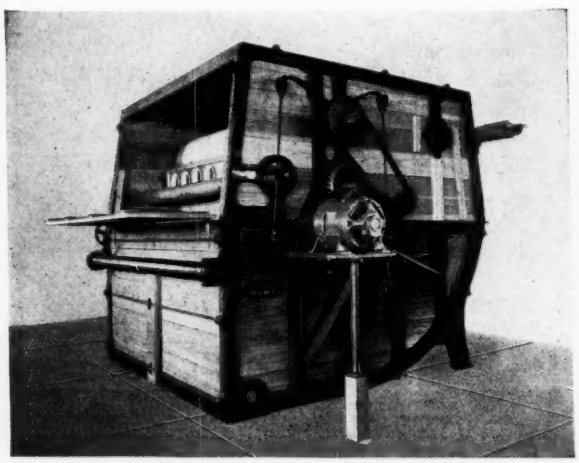


equipment is mounted above the tub where it is away from moisture due to splashing. The counter-balance stop motion is claimed to be set for very light action, stopping the motor immediately should tangles occur.

"Slack Loop" Bleach House Washer

This is a modern machine for the continuous wetting out, rinsing and washing of woven and knitted fabrics in the string. It is said to process the cloth gently without stretch or distortion, and is provided with a wringer for giving the goods a final squeeze before they leave the machine.

This washer has been built to meet shallow pit conditions, and the company claims that it has proven particularly successful in operation with either the peroxide or chlorine process of bleaching.



It is claimed that the counter current flow principle makes a great saving in the amount of water used, and in conjunction with the "slack loop" principle, insures a more efficient rinsing.

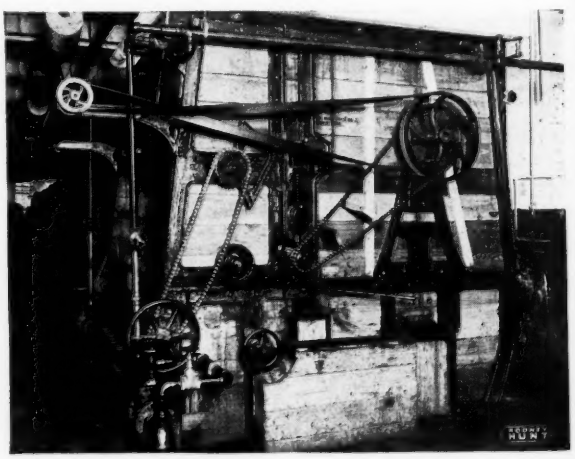
"Clipper" Cloth Washer

The new Cloth Washer is said to incorporate a total of fourteen improvements. Among these improvements is a new sheet spray design which throws an unbroken sheet of water onto the goods, and which is claimed to reduce the time of rinsing materially. Another change is the inclined non-leaking suds box with a two-way discharge valve at the lower end.

The Duplex Take-over attachment is a simple and effective method for threading the goods in a continuous spiral rope through the washer. This is claimed to accomplish a more positive changing of folds, and thus decreases the possibility of washer wrinkles. It is also said to put the goods in a form to be fed to the vacuum extractor.

Combination Washer and Dye Kettle

This is a very flexible machine and can easily be made room for in any finishing room. It is said to



effect a remarkable saving in time, labor and floor space; claims being based on the performance of the initial installation.

Goods are taken from the fulling mill directly to this combination machine where they are loaded and sewed. They are then washed and rinsed, dyed and rinsed and speck dyed and rinsed without being removed.

Proceedings of the American Association of Textile Chemists and Colorists

The American Association of Textile Chemists and Colorists

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SUMMER OUTING OF THE PIEDMONT SECTION, MYERS PARK CLUB, CHARLOTTE, N. C., JULY 12th, 1930

Practically all of the members of the Piedmont Section packed up their troubles and left them in some old dye vat while they attended the second annual outing of the section on July 12th at the Myers Park Country Club. You would never suspect that there might be a dull spell in the textile industry by the manner in which the members so thoroughly enjoyed themselves at the outing.

Golf was the popular event of the day for the followers of Bobby Jones. About fifty members teed off for the tournament. The following finished "in the money":

1st Low Gross, J. W. Huffaker, duPont Rayon Co... 84
2nd Low Gross, A. F. Bean, Yarns Corp. of Amer... 85
1st Low Net, R. D. Sloan, Standard-Coosa-Thatcher. 68
2nd Low Net, R. R. Dorsett, Rohm & Haas Co..... 71
Booby, A. S. McDaid, Southern Worsted Corp.....124

Mr. McDaid made the best acceptance speech at the presentation of the golf prizes. His speech is given here in full.

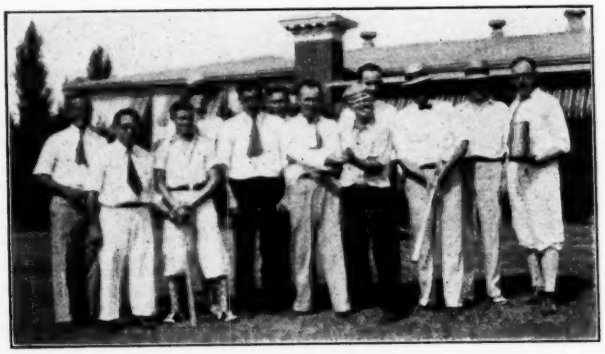
"I counted my score."

A. S. McDaid. (Applause, applause)

The baseball game between the Mill Men and Traveling Men caused considerable excitement. The outstanding features of this event were: The catching of Boo Hodges of Fairforest Finishing Co., Spartanburg, S. C.; the collision between John Pickup and the traveling Short Stop while John was stealing third base; Jos. Simms at first base; Karl Ginter as Umpire.

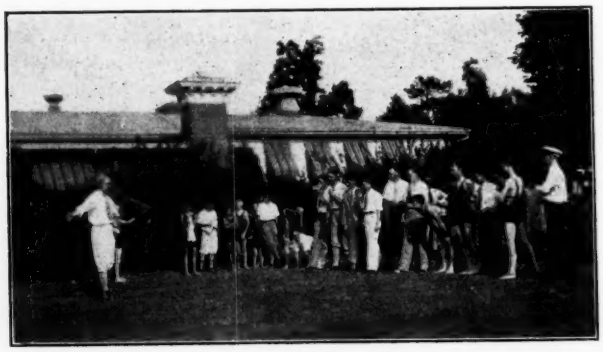
Chairman Mitchell imitating Babe Ruth. Dick claims this was a foul ball? ? ? Note ball above Chairman's hands.

Chairman Mitchell makes home run. See accompanying action picture where salesmen pitcher have "Dick" three and two just prior to knocking home run. The game ended a tie after five innings—Score 27-27.



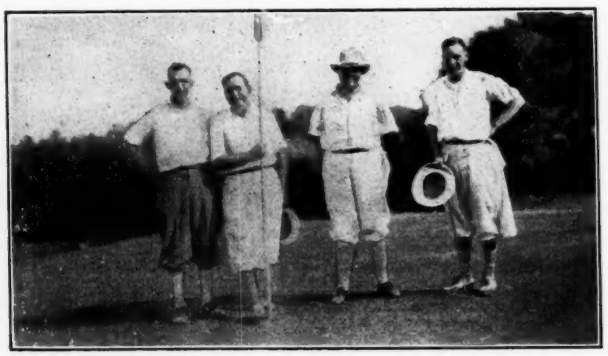
The winning baseball team.

The Pipe Race won by Hugh Puckett of Chas. H. Stone Co. showed conclusively that only a salesman can light and smoke a pipe while on the run.



Secretary Thompson explaining the Pipe Race.

The traveling men and mill men split honors in the quoit tournament. Mike Stough of John Campbell Co. proved that when business is quiet horseshoe pitching can be indulged in. Jos. Simms of the Renfrew Plant carried away second prize.



Left to right: Henry Constable, DuPont Company; J. G. Holt, Abefoyle Mfg. Co.; Samuel L. Hayes, Vice-Chairman, Hartsville Print & Dye Works; Doug Newman, Treasurer, Piedmont Section, DuPont Co. Note: Judy Holt with flag wins foursome.

The Water Polo contest resolved itself into a drowning contest, but Chester Eddy of the Renfrew Plant and Jack Kilheffer, Newport Chemical Co., won prizes for scoring the most goals.

The Trap Shooting tournament between the Tar Heels and the Boll Weevils did not mature as there were not enough Boll Weevils (South Carolinians) present to get up a team. This event may have been revived later in the evening after the meeting, but we fear the boys spelled Trap with a capital "C."

The Banquet was served at the Club to a happy crowd of about 250 members, guests and their wives. The excitement quieted down just long enough to hear P. J. Wood, Vice-President of the Association, deliver an informal talk on "Our Association." The dinner was interspersed with dancing and singing numbers by several very popular female artists in this section. The dancers showed an unusual fondness for several of our more dignified members—ask Charlie Stone, W. R. Pollack and Sam Hayes for details.

Vice-Chairman Samuel L. Hayes of the Hartsville Print & Dye Works added to the merriment and spirit of the occasion in the presentation of the prizes to the lucky athletes in the afternoon program.

T. R. Johnson, Southern Franklin Process Co., Greenville, S. C., received a beautiful fountain pen in the drawing of cards sent in making reservations for the meeting. This plan will be followed at the next meeting, and a very handsome and useful prize will be given to the lucky man whose returned reservation card is drawn from the hat at the next banquet. This plan helps to get reservation cards in on time.

One of the features of the banquet program was the address by Charles Ketchum, Secretary of the Chamber of Commerce, Greensboro, N. C., in his impersonation of a big German Industrialist coming to America to establish huge fabrication plants and chemical laboratories all over the South. This speech was the outstanding event of the year. Ask Sam Hayes who is reported to have bought some preferred stock in the new enterprise.

Chairman Mitchell appointed the following nominating committee to submit nominations for next year's officers:

Malcolm MacKenzie, *Chairman*, Charlotte, N. C.
H. A. Barnes, Greensboro, N. C.
T. R. Johnson, Greenville, S. C.

Election is to be held at the Annual Meeting about October 18th, 1930.

The meeting adjourned at ten o'clock and general dancing was enjoyed till midnight.

The Second Annual Outing and Banquet was the cause of many "humorous" and unexpected events that lingered in the minds of many for several days afterwards. Our next banquet at the annual meeting, October 18th, will be quite different.

Attendance 250.

Outing Committee:

A. R. THOMPSON, JR.
D. C. NEWMAN
PAUL HADDOCK

Respectfully submitted,

A. R. THOMPSON, JR.,
Secy. Piedmont Sec.

Informal Talk on "Our Association"

By P. J. WOOD

AT THE banquet held in connection with the Summer Outing of the Piedmont Section, Mr. P. J. Wood, Vice-president of the Association, gave an informal talk on "Our Association."

Mr. Wood first reviewed the objects of the Association:

"To promote increase of knowledge of the application of dyes and chemicals in the Textile Industry.

"To encourage in any practicable way research work on chemical processes and materials of importance to the Textile Industry.

"To establish for the members channels by which the interchange of professional knowledge among them may be increased."

Then he proceeded to enlarge upon the third item and showed how these objects might best be accomplished.

He spoke of the benefits of the contacts made at meetings, pointing out that they were especially valuable to members of that section because the men were usually so widely separated. It was stressed that there was a great need for a more general discussion of papers that were read, and the desirability of doing everything possible to overcome diffidence shown by many members to these discussions was emphasized.

Encouragement of the younger members was urged. Mr. Wood appealed to the older men to take an interest in the Junior Sections, calling attention to the fact that the attendance of older men, and the presentation of papers by them at the Junior meeting, would do much to increase the interest of these younger men.

An appeal was made for a better representation of the Southern Section at the Council Meetings. The speaker pointed out that according to the new rulings, it is now possible to send a substitute representative when the regular member is unable to attend.

The United States Institute for Textile Research was spoken of briefly. With reference to the possibility of funds being received from the Textile Foundation, Mr. Wood said that any such help should be used only for pure research, and applied research should be carried on with funds received from the industry.

In closing, Mr. Wood extended to the Southern Section the greetings of the Northern Section, and particularly the greetings of the New York Section of which he is a member.

REPORT OF THE LIGHT COMMITTEE, JUNE 27, 1930

The Light Committee on June 12 submitted to Dr. Olney a statement in reply to the paper by Dr. Paul Krais, published in the REPORTER on January 6, 1930, page 33, in which Dr. Krais urged the adoption in this country of the standards recommended by the German Echtheitskommission for testing the light fastness of dyes.

The Committee points out that it has already tested the German standards, but finds that some of them are not at all suitable for our uses, either because they do not possess the right degree of fastness, or because the fading is not sufficiently clean-cut and definite to show when the proper end-point has been reached, or for other reasons. The chief characteristics of a successful "standard" are summarized as follows:

1. It must show a different amount of fading for each period of exposure, the differences being clear-cut and easily distinguished. 2. It must show approximately the same relative degree of fading with and without glass, exposed to sunlight continuously or intermittently, or exposed in the carbon lamp. 3. It must be a well-known dye of definite composition applied by a simple method and easily duplicated, and the dyeings must not change in color when stored.

The German standards are taken up one by one and their behavior when exposed to the standard sun test of the Committee is discussed. The Committee admits that the dyeings which were used in these tests may not have been entirely free from criticism, from Dr. Krais' standpoint, because they were not prepared in Germany under controlled conditions; and it offers to repeat the tests if a new set of dyeings can be obtained which have been made under the auspices of the Echtheitskommission. In the meantime, the Committee concludes, it is searching for standards of its own which will meet the requirements previously mentioned.

In this connection we might add that the Journal of the Society of Dyers and Colourists (England) in its issue of May, 1930, page 165, published an account of a conference between the Fastness Tests Committee of that Society and Dr. Krais, in which the latter urged the adoption of the German standards in England. We quote from the Journal:

"It was pointed out by the British Committee that the German standards had been examined thoroughly by their research workers, and that a number of anomalies existed which were of such a nature as to preclude the acceptance of the standards in their present form."

Respectfully submitted,

WILLIAM H. CADY, *Chairman.*

NEW YORK SECTION OUTING

Seventy members and guests attended the annual outing of the New York Section of the American Association of Textile Chemists and Colorists on Friday, June 27, at the Elmwood Country Club, Paterson, N. J.

The golf tournament was one of the most successful in years. The cup for low gross score was awarded to P. R. Mackinney; that for low gross to Charles L. Kloss; guest prize to B. Bernard. The horseshoe pitching contest was won by Mr. Von Bergen.

At the meeting, Chairman Gaede named the standing committees for the current year. These are as follows: Sectional Committee, P. J. Wood, chairman, P. F. Kingsbury and Herbert Grandage; Program Committee, Giles Low, chairman; Membership Committee, Daniel P. Knowland, chairman; Arthur F. Wiehl, C. A. Puller, G. H. Alpers and P. H. Stott; National Nominating Committee, Henry F. Herrmann.

Respectfully submitted,

CLEMENS F. HOPPE, *Secretary.*

APPLICANTS FOR MEMBERSHIP

Active Membership

Franklin, Jerome A., salesman, DuPont Co., Charlotte, N. C. Sponsors: D. C. Newman and J. D. Sandridge.

Grant, Robert J., manager, Noil Chemical & Color Works, 152 West 108th Street, New York, N. Y. Sponsors: George C. Lommel and A. L. Benkert.

Gray, David, salesman, United Chemical Prod. Co., Jersey City, N. J. Sponsors: R. S. Wheeler and L. R. Hiller.

Levine, Harry, laboratory director, Silk Grading & Testing Lab., 381 Fourth Ave., New York, N. Y. Sponsors: W. F. Edwards and W. M. Sullivan.

Max, Dr. Fritz, chemist, General Aniline Works, Grasselli, N. J. Sponsors: H. E. Hager and H. Meyer.

Mosheim, J. D., dyer, Crystal Springs Bleachery, Chickamauga, Ga. Sponsors: T. C. Perry and R. S. Wheeler.

Walton, Thomas L., overseer of bleaching, Hartsville Print & Dye Works, Hartsville, S. C. Sponsors: Samuel L. Hayes and A. J. Bearcovitch.

ASSOCIATION BADGES

The lapel button badge illustrated herewith is worn by members of the American Association of Textile Chemists and Colorists.

The three "rings" are enameled in red, yellow and blue, respectively, and the initials and border are brought out in gold. The general effect is exceedingly attractive.

Badges may be secured at $1.50 each by addressing the Secretary.

ALEX. MORRISON,
American Woolen Co.,
Andover, Mass.

AMERICAN DYESTUFF REPORTER

Devoted to the use and application of dyestuffs and the mechanical equipment incidental thereto.

LOUIS A. OLNEY
Professor of Chemistry and Dyeing, Lowell Textile Institute
Directing Editor

WILLIAM HOWES COLLINS
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OBSOLESCENCE THE PRICE OF PROGRESS

EVER since metal first replaced the implements of the stone age, obsolescence in machinery has been the price of progress. With respect to the textile dyeing and finishing industries, this has been particularly true. One could write books on the developments and changes in machinery design which have forced the older machines out of use.

Depreciation, in the guise of wear and corrosion, is a constant enemy of the dyeing and finishing industry, but obsolescence puts in its work many times as rapidly. Antiquated machines and methods of processing have been large factors in retarding the business of many concerns. If demand slackens, mill men, of course, wonder why. The next step is to find out why. If the answer points to the scrapping of outworn machinery or methods, and to plant reorganization on a scientific basis, the indicated procedure is plain enough. Under such conditions, the mills, which, in an orderly and reasonable manner changed their tactics, especially the first ones to change, now hold the most favorable positions in the textile industry. The old adage, to let "well enough alone," can be carried too far; oftentimes "well enough" keeps getting worse.

Some textile manufacturers might well take a lesson from one of the most modern of our industries, the automobile industry—modern in the sense of progressiveness. Time and time again in the manufacturing of automobiles, companies have scrapped machinery not a little of which was almost new. Why? Because it was found to be more profitable in the long run to give the consumer what he wanted instead of what he had to take.

When one is considering the scrapping of old machines and the installation of new, there are, to be sure, many things to be considered. First and foremost is—will the replacement increase profits? The new machine may be cheaper to operate; if so, the grade of goods produced should be carefully examined, for quality of product always must be kept in mind. Sometimes it is found that a new machine is more expensive to operate; if so, one has to consider that the increased salability of the product might more than make up for the increased production cost.

Another factor which has a powerful influence on changes on certain types of finishing machinery is the question of style. There is nothing that can make a perfectly good machine become obsolete quicker than style. A machine may be used to manufacture a special fabric that happens to be in vogue; when the vogue passes the machine will become useless. In buying a machine that falls in this class, it is well to try and determine the probable length of time the machine may profitably be used for its specific purpose. Furthermore, with an eye on style, changes, it is worth while to note whether or not the machine is so designed that new improvements may be fitted to it.

At the present time, machinery manufacturers are more alert than they ever have been. They spend more time listening to what the mills have to say about their problems and really collaborate with them. They do not hesitate to spend money for research, and as a result have made remarkable strides. Many mills by taking advantage of such cooperation have saved themselves hundreds of thousands of dollars.

In a man old age is inevitable, but in a manufacturing plant worn or obsolete machinery may be replaced. Modern machinery, installed with judgment and foresight, may easily take less power, cut down labor costs and enable the mill to produce fabrics for which there is a demand.

THE AUTUMN "GET-TOGETHERS"

CERTAINLY at no time in recent years have business men been impelled to seek mutual counsel, and the sustaining and inspirational results of such counsel, more than at the present. Problems of well-nigh universal interest press for attention, and there is a well developed desire to talk things over. In industrial groups, special matters affecting those groups call for mutual consideration in the common interest—such matters, for example, as research, expansion, effectively continuing advertising policies, managerial development, market surveys—all these things, and many others, which may and should be considered frankly and freely are to the forefront now; the meetings of the coming Autumn, whether in the form of conventions or other state business gatherings of importance, or the sociable group luncheon meet-

ings, offer opportunities for presentation and discussion.

It is not too early for the program makers to begin to study how to emphasize the real benefits of the "get-togethers" of business men this coming season. Neither industrial leaders, nor the rank and file, can feel that the time dedicated to a meeting is profitably spent when topics of relatively minor interest are featured on the agenda. This does not mean that only subjects of the utmost seriousness are to be selected; still less does it mean that the treatment of any subject should be of that serious character which, quite appropriately, is called deadly; for nothing equals a bit of understanding humor in illuminating a situation or pointing the way to its betterment. It does mean that when many matters of engrossing interest are available for discussion, one or more of them can fittingly be chosen as program topics.

Oftentimes the round-table discussion, intelligently led, is the most valuable of all. It is not always the set speaker that does the most to contribute. Many a man has ideas very much to the point on a subject with which he is familiar, and if he is encouraged to express those ideas the entire group is the gainer. The livelier the discussion and the greater the number of worth while angles presented, the more everyone gains.

Men frequently become obsessed with their own particular difficulties, or what they consider to be such; and, when this is the case, they need to rub elbows with others to obtain, for their own benefit, a broader and more constructive outlook. This outlook can, of course, be given, and with this purpose in mind, the business "get-togethers" of the coming Autumn should prove to be distinct assets.

EDITORIAL NOTE: In the article entitled "Bleaching Cotton Piece Goods in One Boil," published in the July 21st issue of the REPORTER, the author inadvertently and unfortunately used an illustration which was not at all suited to the text. The illustration referred to is of a yarn kier built by the Textile Finishing Machinery Company of Providence, R. I., while the kier described in the article is a cloth kier of an entirely different make.

We are sorry that such an error should have occurred and will endeavor to rectify it by the publication in a future edition of the REPORTER an article descriptive of the Textile Finishing Machinery Company kier.

L. A. O.

EXTRACTORIALS

Businesses which go to their limit to carry their employes over slow seasons with unimpaired purchasing power accumulate invaluable assets of good will, and also save themselves the inefficiency of untried help when business again picks up. From the standpoint of long-run profits, the value of a satisfied, time-tried staff is undoubted.—*Business Bulletin.*

Opinions in informed circles is that the American manufacturer who is not paying some attention to the possibilities of export business is an American manufacturer who is not paying enough attention to the possibilities of his own business.—*Fairchild Publications.*

The dye, chemical and machinery manufacturers are in possession of information of the greatest value to the textile industry and which will aid greatly in placing that industry upon a profitable basis, even in these days of depression, all of which they are anxious to place at the disposal of the industry, and the textile manufacturer who does not seek their aid and adopt their newest improvements in painting "Failure" upon the door of his mill.—*Textile Colorist.*

As a result of facts such as these plus the suspicion that has arisen with regard to guaranteed fast colors that have proved to be fugitive, many of the leading manufacturers and retailers of the country have insisted upon producing and selling colors that actually give reasonable satisfaction. As an indication of the manner in which the textile industry is adopting fast colors, it has been reported from a survey of the advertising pages of some 40 magazines that over 50 different trade marked brands of fast colored fabrics were being nationally advertised. As far as dyed and printed cottons are concerned, the color situation is gradually clearing itself up.—*G. H. Johnson, Bulletin—Laundryowner's Nat'l Ass.*

There have been sporadic wage reductions, and there may be others, but the determination of representative captains of industry to maintain wage scales is one of the best assurances of a business revival on a sound basis, as soon as demand and supply are brought into a better alignment. And one of the surest ways of postponing the return to normal would be a concerted effort of employers to "take it out of labor."—*New York World.*

Industrial disputes arise from neglect of the human side of production and commerce, a neglect not due to innate wickedness or tyranny of either side, but to lack of understanding and imagination.—*Sir George Newman.*

Labor sentiment is crystallizing in favor of modified production and steady employment. The high wage return is not the burning question. Among the puerile curb chatter is the suggestion that capital is out to discipline labor. A fallacy. The old timers say capital is out to save its own hide and protect labor. It will pay the highest possible wages.—*Joseph Wild, Daily News Record.*

In the last analysis, the struggle of man with nature reduces itself to the principle of obtaining maximum results with a minimum of effort. This is what we call "efficiency."—*H. M. Knipfel, United States Daily.*

Elementary Textile Microscopy

Part V—Photomicroscopy

Definition and Advantages—Principle and Steps Involved—Types of Apparatus—Illumination—Microscope—Camera—Calculation of Magnification—Use of Apparatus—Calculation of Exposure—Determination of Standard Exposure—Color and the Use of Color Filters—Natural Color Photography—Darkground Illumination and Polarized Light—Depth of Focus—Routine and Recording of Data.

By **JOHN H. SKINKLE**

Department of Chemistry, Lowell Textile Institute

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(Continued from issue of August 4, 1930.)

PHOTOMICROSCOPY may be defined as the photography of materials of microscopic size. The resultant photograph is called a photomicrograph and has the advantages that the resultant picture may be studied at ease and filed as a permanent record for future review, several results from various samples taken at different times or places may be compared, and above all that the resulting photograph may be understood by one who has no technical knowledge of the means used in obtaining it.

Principle and Steps Involved

The image formed by a microscope is further enlarged by a camera, focused on a ground glass screen, and then recorded on a photographic plate or film. The steps involved are obviously the supporting of the apparatus by means of an optical bench or support; the support and magnification of the object by means of a microscope; the illumination of the object by appropriate means; and the recording and further enlargement of the image.

Types of Apparatus

We may classify the photomicrographic apparatus by the size of the final negative which is usually 8 x 10, 5 x 7, 4 x 5, 3¼ x 4¼ or 1⅝ x 2½ inches in size. According to the positions of the camera and microscope we may classify apparatus as horizontal or vertical; and according to the support for the camera as follows:

1. With optical bench for horizontal position—the optical bench gives freedom from vibration because of its great weight, by the use of rubber pads, or because of springs in which the apparatus is slung.
2. With a vertical rod for vertical position.
3. A combination of the above two by means of which the position may be either vertical or horizontal.
4. A tripod supporting the camera above the microscope—this type is practically obsolete.
5. The weight of the camera is placed directly on the microscope—this is done only with small size (1⅝ x 2½") cameras and is not to be recommended for precise work.

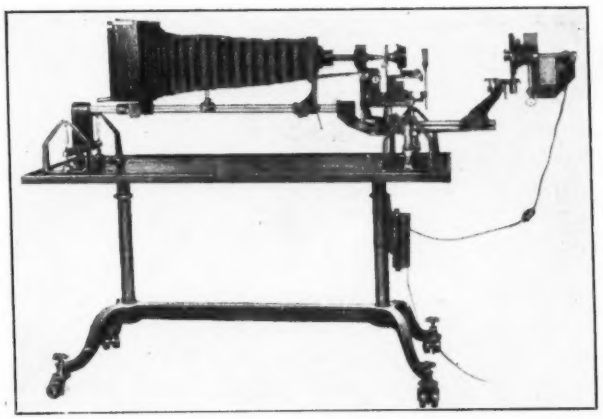


Fig. 81

Horizontal Photomicrographic Apparatus.

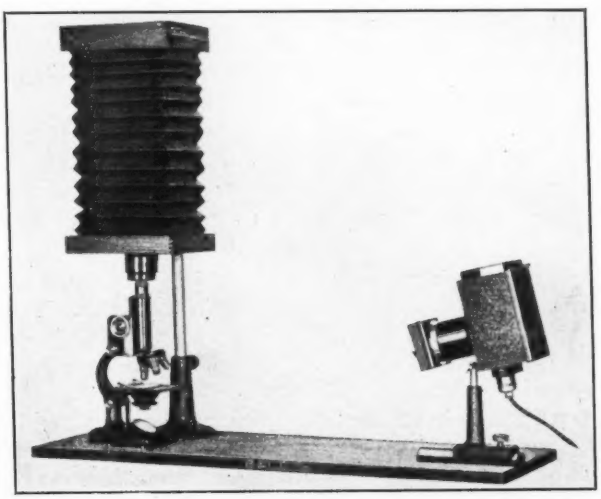


Fig. 82

Vertical Photomicrographic Apparatus.

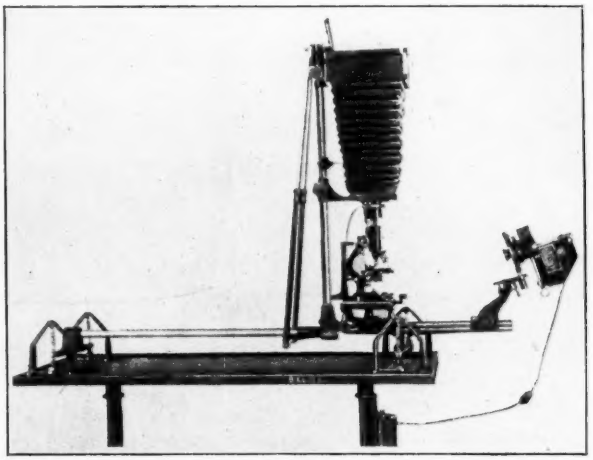


Fig. 83
Combination Photomicrographic Apparatus

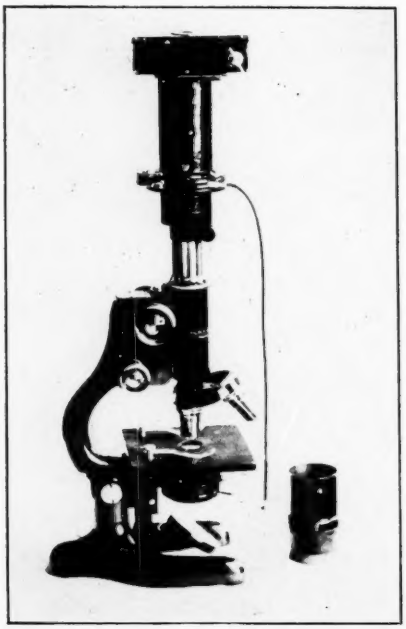


Fig. 84
Lucas Photomicrographic Apparatus

Illumination

For transmitted light, daylight is generally unsatisfactory and should be replaced by light originating at a single point or plane and capable of being sharply focused. The arc light is generally used, with the 6-volt, 108 watt ribbon-filament Mazda light second in popularity. The Point-O-Light, an enclosed tungsten arc is also suitable for use in photomicroscopy. A condenser with an adjustable diaphragm and a liquid heat filter should also be used to project an image of the light source into the plane of the substage condenser diaphragm of the microscope. These condensers usually consist of two plano-convex lenses and are usually adjusted for spherical aberration only, for this reason, a color filter should be used.

For reflected light, Mazda lamps, arc lights, Silvermann Illuminators, and vertical illuminators are used. The author has found that a Kliegl lamp of 500 or 1000 watts is suitable in textile work for reflected light, and even for transmitted light if the mirror of the microscope is used.

Microscope

The microscope used on photomicrographic apparatus should have a substage condenser and preferably a wide body tube to prevent internal reflections. In regard to lenses, flatness of field is of primary importance and apochromatic objectives and compensating oculars should be used if possible. By using monochromatic or filtered light, achromatic lenses give good results in most cases. Filters should always be used with magnifications greater than 100 x.

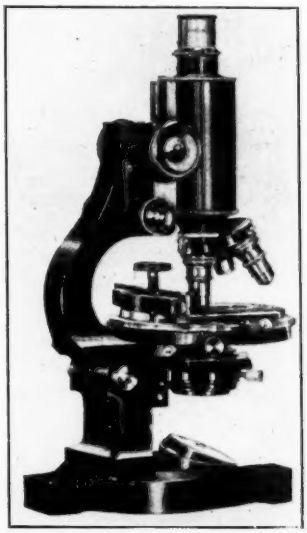


Fig. 85
Microscope for Photomicroscopy

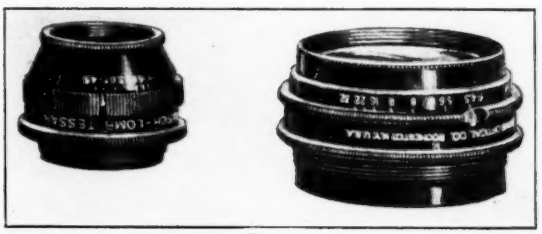


Fig. 86
Micro Tessar Lenses

Camera

The camera may be of the fixed focus or extension bellows type. The fixed focus type is light in weight, less complicated, less expensive, but has a smaller range of magnifications; examples of this type are the Lucas apparatus and the Zeiss Photographic Eyepiece, this latter making it possible to watch a specimen and photograph it at the same time. The extension bellows type is bulkier and more expensive but has a larger range of magnifications and should be used where much work is to be done, it may be of the vertical or horizontal type.

The parts of the camera are—the shutter, for making the exposure; the bellows, for varying the magnification; the focusing screen and plate holders, for focusing and recording the image; the light seal for making the microscope-camera connection.

Calculation of Magnification

The magnification of a complete photomicrographic apparatus is the result of four variables and may be approximated rather closely by the formula:

Total magnification = A x B x C x D

Where A = magnification of the objective
B = magnification of the ocular
C = actual tube length divided by standard tube length (160 mm.)
D = camera extension in millimeters divided by 250 or camera extension in inches divided by 10.

Camera extension is measured from the plate or ground glass to the ocular; or if the ocular is not used, from the plate to the objective.

The final result should be adjusted by means of the camera until exactly the desired magnification is obtained.

Use of the Apparatus

The following directions assume the use of a horizontal apparatus with an extension bellows camera, but variations for use on other types of apparatus are slight and obvious.

1. Calculate the objective, ocular, and extension necessary to get the desired magnification and set these on the apparatus.
2. Align the apparatus—adjust the height of the microscope and the light source until the circle of light is in the center of the ground glass and evenly illuminated.
3. Focus the illuminant—with a test object on the stage of the microscope, adjust the extension and diaphragm of the condenser until the substage condenser is flooded with light, then adjust the light by the condenser diaphragm and substage condenser diaphragm until the circle of light on the ground glass is sharply defined and evenly illuminated.
4. Set to desired magnification—replace the test object by a stage micrometer, focus sharply by means of the microscope focusing adjustments, and measure the size of the image of the micrometer division by means of dividers and metric rule. Adjust the camera extension until the desired magnification is obtained.
5. Photograph—replace the stage micrometer by the mounted specimen, focus sharply on the ground glass. Close the shutter of the camera, remove the ground glass, insert the plate holder and withdraw the dark slide. Expose by opening the shutter for the correct time. Close the shutter, replace the dark slide, remove plate holder, and develop the plate.

Calculation of Exposure

The factors influencing the exposure in photomicroscopy may be tabulated as follows:

1. Illumination
   a. Intensity and spectral characteristics of the light source.
   b. Condensing system as it affects the amount of light utilized.
   c. The color filter used, if any.
2. Object photographed
   a. Immersion medium between the object and the objective as it affects the numerical aperture of the objective.
   b. Mounting medium.
   c. Density or transparency of the object.
   d. Contrasts present in the object.
   e. Color of the object.
3. Lens system
   a. Numerical aperture of the objective.
   b. Total magnification used.
4. Sensitive plate
   a. Speed.
   b. Color sensitiveness.

At first sight, it may seem that it is impossible to consider all of these variables in calculating an exposure; but if the following approximations are considered, it may be seen that the task is not so difficult.

1. If the substage condenser is always flooded with light, the illumination for any one machine is practically constant, except for changes of color filters.
2. The object photographed is essentially constant for any one class of work, such as fiber photomicroscopy.
3. The lens system must be corrected for, but its numerical values may be obtained from tables.
4. The sensitive plate factor is constant if the same kind of plate (such as panchromatic plates) is always used. If a different sort of plate is used, however, a definite exposure factor may be used.

The variables left, which must be corrected for, are:

1. Color filter.
2. Numerical aperture of objective.
3. Total magnification.
4. Sensitive plate.

The method used is to find a standard exposure for a fiber on the machine to be used using no color filter, a standard sensitive plate, a standard magnification, and an objective of standard N.A. This standard exposure may then be corrected for any change in conditions on the same machine by the following formula:

$$E = Es \times F \times P \times \frac{(NAs)^2}{(NA)^2} \times \frac{(M)^2}{(Ms)^2}$$

in which E = correct exposure
Es = standard exposure
F = filter factor
P = sensitive plate factor
NA = numerical aperture of objective used
NAs = standard numerical aperture
M = magnification used
Ms = standard magnification used.

The numerical aperture of an objective is usually given

on the objective or may be obtained from the manufacturers' tables of properties (see appendix).

The magnification may be measured, or calculated as shown.

The filter factor is obtained from manufacturers' tables (see appendix).

The plate factors, based on a speed of one for panchromatic plates may be taken as:

Panchromatic plate	= 1
Ordinary plate	= ½
Speed plate	= ¼
Process plate	= 4
Natural color plate (Agfa	= 30

The determination of the standard exposure is given in the following Section.

Determination of Standard Exposure

Using the 16 mm. objective (use its N.A. as the standard N.A.) and with a total magnification of 100 x, focus on a fiber mounted in Canada Balsam, using no color filter. Put marks on the dark slide of the plate holder, dividing the plate into four parts. Withdraw the dark slide and expose the whole plate for one unit of time; close the dark slide to cover one quarter and expose for one unit of time; close the dark slide another quarter and expose for two units of time; close another quarter and expose for four units of time. This gives a plate with four exposures of one, two, four, and eight units of time. Develop the plate and determine the correct exposure for these standard conditions. The first unit of time may be taken as five seconds, and if the first plate has no correct exposures, the unit may be increased or decreased depending on whether all the first four exposures are too little or too much.

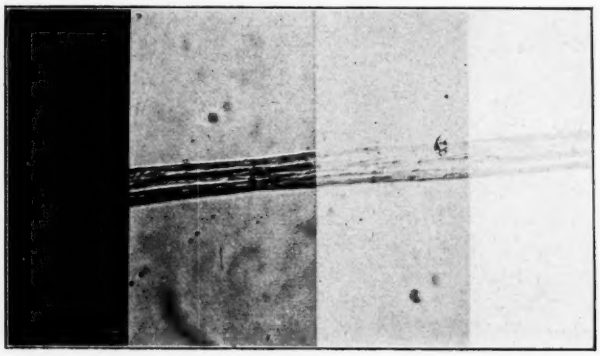


Fig. 87
Determination of Standard Exposure

Color and the Use of Color Filters

The ordinary definition of the color of an object is the color of the light reflected or transmitted by the object. This definition holds true in ordinary daylight, but according to it, a red glass in a green light would have no color, because there are no red rays to be reflected or transmitted; it is better therefore to consider the color of an object in terms of the light absorbed by the object which would give a definition holding under any conditions. According to this, then, a red object is one which absorbs all colors except red, and if we employ the three primary colors of the physicist, we say that a red object is one which absorbs the green and the blue-violet. The accompanying figure shows the visible spectrum of white light in terms of these three primary colors and the transition colors between the primaries.

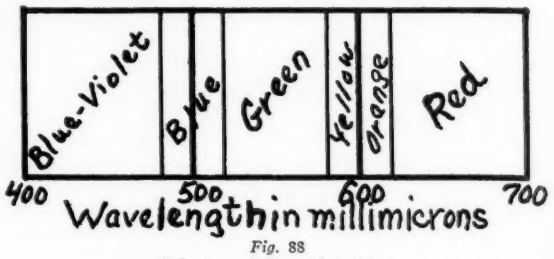


Fig. 88
Primary and Transition Colors

The following show the resulting colors obtained when an object absorbs a wide portion of the spectrum, consisting of one or two complete primary colors.

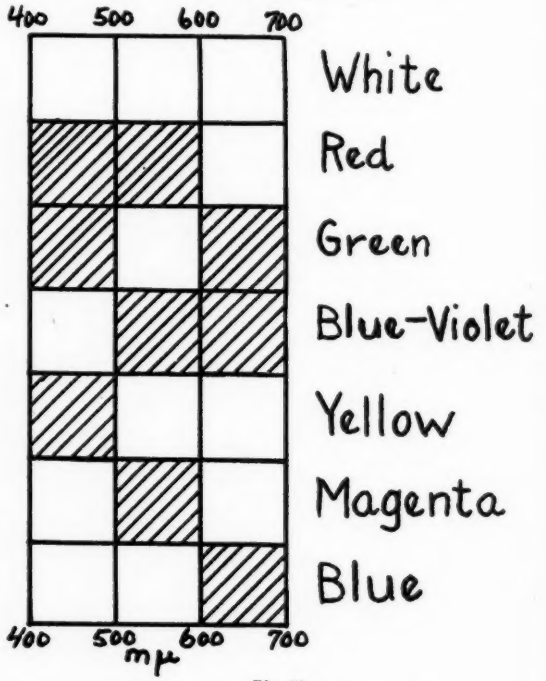


Fig. 89
Colors Formed by Wide Absorption Bands

If we consider objects which absorb only a fraction of a primary color, we may obtain a further range of colors as in Figure 90.

True dyes and coloring matters do not, however, give sharp and definite absorption bands. Figure 91 contrasts theoretical and actual absorption bands for two colors, which show that absorption is only relatively greater in one portion of the spectrum and includes a decrease in intensity of other portions.

A further complication enters when we attempt to record colors photographically, in that the sensitivity of the eye to various portions of the spectrum is different from the sensitivity of photographic plates. Figure 92

shows a plot of the eye and plate sensitivities toward various wave lengths. It is clear, then, that if the photograph is to give an exact record of what the eye sees, it must be corrected in some manner. The apparatus used for this correction is called a color filter and consists of dye gelatin of definite transmission and absorption properties. The best set of such filters is the Wratten "M" series made especially for microscopy and which may be obtained in three grades—the "A" or gelatin film between optically flat glass; the "B" or gelatin film between white optical glass; and the plain gelatin film. A table of the names, transmission ranges, absorption spectra, and exposure factors of these filters is given in Table XII.

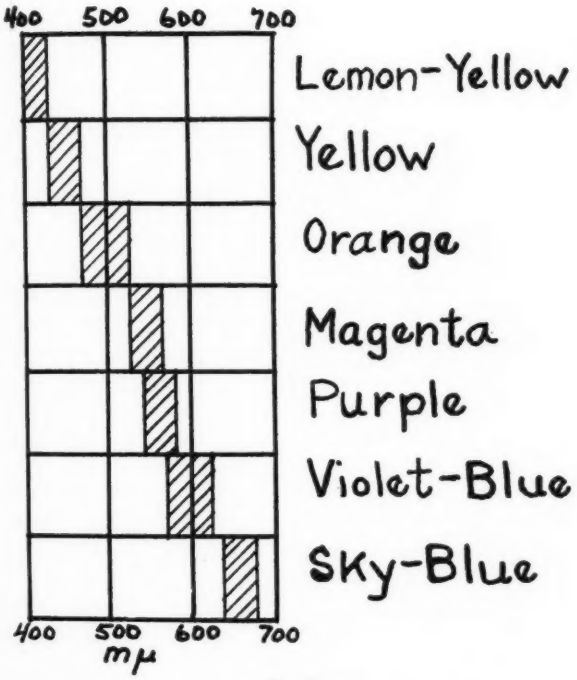


Fig. 90
Colors Formed by Narrow Absorption Bands

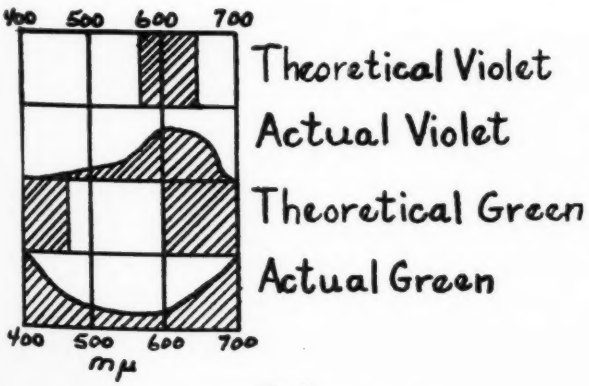


Fig. 91
Theoretical and Actual Absorption Bands

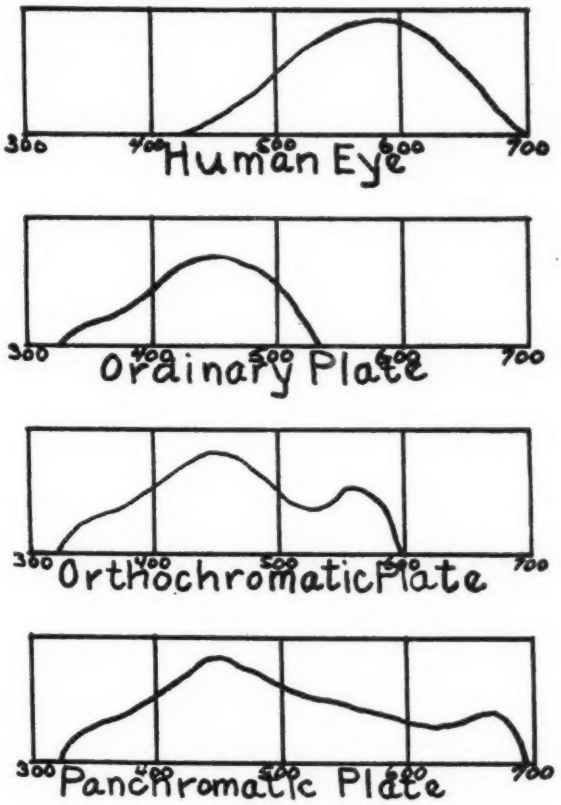


Fig. 92
Sensitivities of Photographic Plates

The general rules for the use of color filters in microscopy and photomicroscopy may be summarized as follows:

1. To improve resolution and sharpness of outline, use a monochromatic filter with transmission in the yellow-green portion of the spectrum corresponding to the best correction of the objective. This is the K-1 filter.
2. To increase contrast, use a filter complementary in color to the object or, in more scientific terms, a filter which absorbs the color of the object.
3. To increase detail and decrease contrast, use a filter corresponding in transmission to the color of the object.
4. To get a correct color rendering, use a panchromatic plate and the filter for it (K-1 or G).

As examples: if the object is stained green use the A, F or C filter for contrast; the B filter for detail; and the K-1 or G filter for correct color values. If the object is brown (an impure orange) use the C or H filter for contrast, the A filter for detail, and the K-1 filter for true values.

Natural Color Photography

In natural color photography, there is at present only one method of obtaining prints on paper—this is the two or three color subtractive process which is similar in principle to the Bromoil and Carbro processes. This

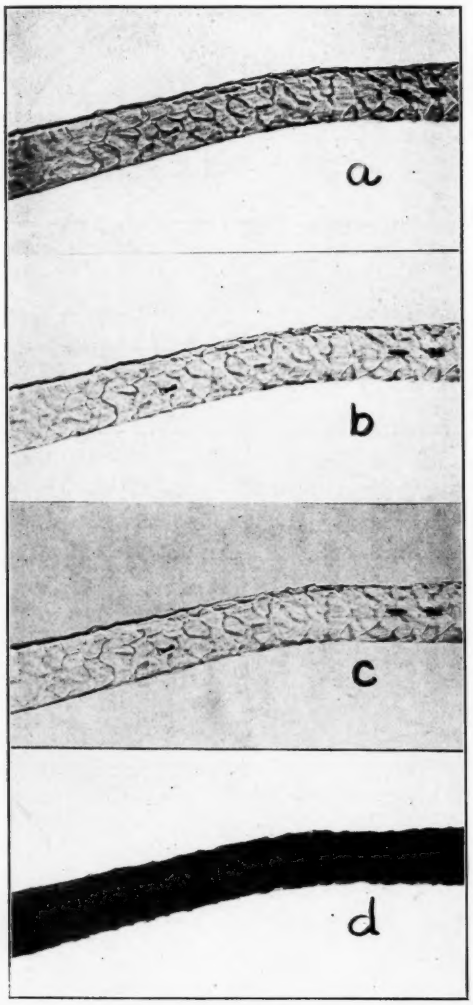


Fig. 93
Red Dyed Wool Fiber Photographed
a. With no filter
b. With K-1 filter
c. With A filter
d. With B filter
(200 X)

process is somewhat complicated and requires perfect registration. An excellent description of a successful routine is given by Curtis in the Journal of the American Ceramic Society (August 1928) to which the student is referred for further information.

For glass transparencies, the process is simpler and quicker. These may be made by one of three principles. The three color additive process consists of taking three photographs, using the Wratten A, B and C filters, printing slides from these negatives; dyeing them with colors complementary to the filter used, and then super-imposing the images either optically, by separate projection lanterns or mechanically by binding them together. The Paget screen plate process uses a screen of close ruled lines to break down the entering light into its components, making a negative, printing a positive, and binding the positive with a screen to reverse the process on projection. The Agfa and Autochrome plates use colored starch grains as screens in making a negative which is then reversed and projected thru the same screen. The exposure with the Agfa plate is thirty times the exposure necessary on panchromatic emulsions and therefore requires perfect rigidity of the apparatus used. The author has found the Agfa process simple in operation and of value in the study of such phases of microscopy as absorption of dyestuff and spreading or running of the dye in printed fabrics.

Darkground Illumination and Polarized Light

By the use of these two methods of illumination a good contrast is obtained and more information as to fibers may be obtained. Darkground illumination gives considerable increase in detail, especially of the surfaces of fibers. Polarized light shows the internal structure of fibers much more clearly and is also a valuable aid in identification. In this connection, the use of color plates for recording the colors produced by polarized light on rayons is valuable.

Fig. 94
Cotton Fiber by Darkground Illumination (200 X)

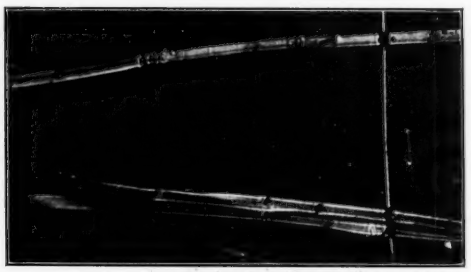


Fig. 95
Flax Fiber by Polarized Light (200 X)

Both of these methods of illumination allow only a small amount of the projected light to fall on the fiber itself and require correspondingly long exposures.

Depth of Focus

Where individual fibers are large in diameter; where several fibers lie in slightly different planes; or when several planes of a fiber are to be photographed at once, as in a wool fiber when the saw-tooth outline and top scales are both required, depth of focus is necessary. This may be obtained by consideration of one or more of the following factors:

1. Use a low-power objective and obtain the desired magnification by means of higher powered oculars and greater camera extension.
2. If using objectives with diaphragm, decrease the diaphragm opening.

3. Use monochromatic light for greater sharpness.
4. Use a process plate for greater sharpness and contrast.
5. Develop with a fine grain borax developer.

Routine and Recording of Data

Consistently good results in photomicroscopy is a matter of continual practice and the development of a satisfactory routine or standardization of method so as to eliminate as many as possible of the great number of variables in the process. It should be made a matter of habit to record all the data necessary to reproduce the negative and this data should be entered either on the envelope holding the negative or in a file with a number corresponding to a number on the negative. The minimum data which should be so preserved is:

1. Name and color of object.
2. Color filter used.
3. Objective used—magnification and N.A.
4. Total magnification used.
5. Exposure used.
6. Criticism of results obtained.

TABLE XIII

Formulae

Wellington Universal Developer—For Plates or Paper

Elon	2 grams
Hydrochinon	6 grams
Sodium sulfite, anhydrous	35 grams
Sodium carbonate, anhydrous	35 grams
Potassium bromide	0.6 gram
Water	1 liter

Dilute 1:1 before using.
Develop 3 minutes at 65°F.

Borax Fine Grain Developer

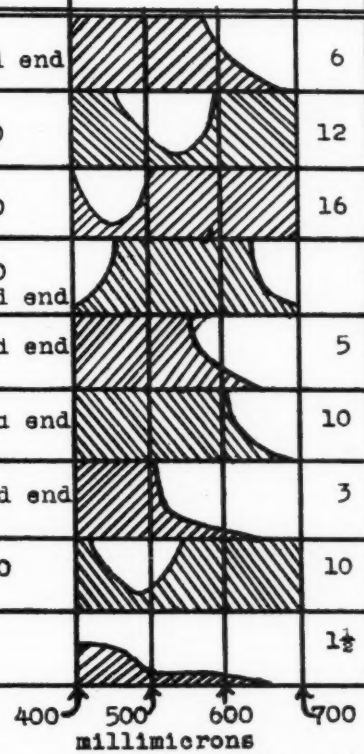
Elon	2 grams
Hydrochinon	6 grams
Sodium sulfite, anhydrous	11 grams
Borax	22 grams
Hot water	1 liter

Use full strength.
Develop 4 minutes at 65°F.
(Keeps indefinitely.)

TABLE XII

Wratten "M" Filters

NAME	COLOR	SPECTRAL TRANSMISSION	TRANSMISSION BANDS	EXPOSURE FACTORS					
				Panchromatic Plates			Orthochromatic Plates		
				Tung. Lt.	Arc Lt.	Sun Lt.	Tung. Lt.	Arc Lt.	Sun Lt.
A	Orange-red	580 - red end		6	10	12			
B	Green	460 - 600		12	13	14	14	20	24
C	Blue-violet	400 - 510		16	13	10	10	9	8
D	Purple	380 - 460 640 - red end							
E	Orange	560 - red end		5	8	9	20	30	40
F	Pure Red	610 - red end		10	18	25			
G	Strong Yellow	510 - red end		3	4	5	12	16	24
H	Blue	420 - 540		10	7	5	10	8	6
K-1	Pale Yellow			1½	1½	1½	2½	3	3



"D" is used only in combination with other filters.

"K-1" is the filter used for orthochromatic reproduction.

EASTMAN MOTION PICTURE DEVELOPER D-76—FOR VERY FINE GRAIN

Elon	2 grams
Hydrochinon	5 grams
Sodium sulfite, anhydrous	100 grams
Borax	2 grams
Water	1 liter

Dissolve the elon in a little water at 125°. Dissolve one quarter of the sulfite in water at 160°, add the hydrochinon, and add the solution to the elon. Dissolve the rest of the sulfite at 160°, add the borax, mix with the developer and make up to volume with cold water.

Develop 15 to 25 minutes at 65°F.

ACID HYPO FIXING BATH

Water	1 liter
Sodium thiosulfate	330 grams

Filter, and add the following hardening solution:

Acetic acid, glacial	6 cc.
Powdered alum	4 grams
Water	25 cc.
Sodium sulfite, anhydrous	4 grams

ACID FIXING BATH—SIMPLER TO MAKE

Water	1 liter
Sodium thiosulfate	250 grams
Potassium metabisulfite	25 grams

FARMER'S REDUCER

20% sodium thiosulfate solution	100 cc.
10% Potassium ferricyanide solution	10 cc.

To stop the action, wash well.

This may be used to increase contrast on a plate by clearing the light portions of the negative.

TABLE XIV

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Matthews—"Textile Fibers"
Olney—"Chemical Technology of Fibers"
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Cohn—"Tests and Reagents"
Lewis—"Introduction to Textiles"
Curtis—"Testing of Yarns and Fabrics"
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" "	Feb. 9, 1929	"
" "	Sept. 28, 1929	"
" "	April 27, 1929	"
" "	May 18, 1929	"
" "	June 22, 1929	"
" "	June 29, 1929	"
" "	Aug. 17, 1929	"
" "	Sept. 21, 1929	"
" "	Oct. 26, 1929	"
" "	Dec. 14, 1929	"
" "	Dec. 21, 1929	"
" "	Jan. 18, 1929	"
" "	Sept. 29, 1928	Johnson
" "	Oct. 6, 1928	Skinkle
American Dyestuff Reporter	April 16, 1928	Schwartz
Industrial and Engineering Chemistry	Feb. 1929	Grier
Journal of the American Optical Society	Any	Various
Journal of the American Ceramic Society	Aug. 1928	Curtis

North Carolina State Summer Course

The largest summer session ever held by the Textile School of North Carolina College closed on July twenty-fifth. During the summer session, courses were offered for men with practical mill experience who desire to increase their knowledge of textiles. Classes in fancy weaving were taught by Dean Thomas Nelson, design and fabric analysis by Prof. T. R. Hart and carding and spinning by Prof. J. T. Hilton. Following the closing of Summer School, these professors joined the other members of the faculty in visiting various textile organizations. The information assembled will be used to keep textile students of the Institution thoroughly posted with the latest developments in the manufacture and finishing of textiles.

The Schlake Dye Works of Chicago have recently purchased the equipment of the American Textile Dye Works of Milwaukee. This purchase will enable them in the future to process cotton and wool piece goods as well as their regular line of skein and package dyeing.

The General Dyestuff Corporation is bringing out a new card illustrating a selection of Naphthol AS combinations on rayon which resist the desulphurizing, boiling and bleaching processes. This card is called "Naphthol AS Dyeings Fast to Desulphurizing on Rayon."

Technical Notes from Foreign Sources

Red Alizarine-Lake, Shade of, as Influenced by Anions of the Mordant

Prof. P. P. Victorow—Mell. Textile-Ber. 10,874 (1929) —It is generally known that pastes containing starch thickeners give deeper and more lively tones than do those made up with gums as the thickening-agent. Sasanow explains this by pointing out that with gum thickeners, hydrolysis of the mordant salt, and consequently formation of the lake, takes place more rapidly than in the case of starch thickeners, and the lake which forms is less firmly attached to the fiber owing to the rapidity with which it is precipitated; and therefore, on washing the goods a part of the insufficiently fixed lake is removed. Thus the residual tone is less bright and less intense.

As far as the influence of the anions of the mordant upon the result is concerned, there are two possible explanations. In the one case, a mordant consisting of the metallic salt of a volatile acid (e.g., acetic acid) is compared with one whose acid component is non-volatile (e. g., a tartrate); in this case, it may be stated that the first kind of mordant breaks down more readily than does the second, and affords a lake which is deposited only loosely upon the fiber, so that when washed, the fabric loses some of the lake and becomes duller in tone. The explanation here made is that mentioned above;—the rapidity of hydrolysis of the mordant. The other explanation points out that mordants which hydrolyze only slowly on steaming (mostly mordants which are salts of mineral acids) hinder the entrance of the iron into the nascent alizarine-red lake; in this case, aluminum chloride is cited as an example. The author quotes as the two points to be considered carefully in this study, the following:

(a)—the rapidity of the lake-formation upon the fiber, on steaming.

(b)—the retarding action of mordants upon the entry of iron into the nascent lake.

The first factor, so claimed, is confirmed by our experience with acetates as mordants, but formates, which hydrolyze as easily, and therefore as rapidly (this in a general sense, of course), gives very brilliant red lakes; so that the slow formation of the dyeing upon the goods is not the decisive factor in producing good reds. The other alternative, that the formates retard (better, slow down) the entry of the iron into the nascent lake in a way similar to the behavior of, e.g. aluminium chloride, etc., has therefore to be resorted to as at least a partial explanation. The purpose of the present paper is to throw some light upon the reason why iron salts in mixture with aluminum salts of organic acids, do not act freely or satisfactorily.

A good deal of experimental work, and discussion of its bearings, makes up the bulk of the article. The important part of the paper (no reflections are cast upon the rest of the paper; the word "important" is used as in connection with a summarizing of the paper as a whole) lies in a paragraph toward the end which we quote:

"To alizarine-red printing pastes prepared according to old recipes, arsenious oxide dissolved in acetic acid used to be added, but the true significance of this addition has become forgotten in the course of time. But, if we look closely into the role of the As_2O_3 in reference to its reducing-power, the importance of the substance as an addition whose purpose is to retard the entry of the iron into the forming lake will be explained. We know that arsenious acid is used in volumetric analysis as a typical reducing agent; e.g., it reduces Fehling's solution, and separates metallic silver from ammoniacal solutions as a mirror. Regarding the reductive activity of arsenious acid in reference to mordant dyeing, Georgeviczs has the following: ferric salts, as we know, are fixed upon the fiber poorly, and the lakes formed with them rub badly; therefore, to produce iron-lakes fast to rubbing, it is necessary that the oxidation of a ferrous salt to the ferric condition be the source of the ferric iron, and that this oxidation take place slowly so that the ferric compound may be formed in the fiber, rather than merely upon and around it. Pure ferrous acetate is out of the question on account of its rapidity of oxidation. We therefore use "pyrolignate of iron", but to prolong the oxidation-process, a solution of white arsenic in acetic acid is added to the pyrolignate which is to be used for dyeing."

The author experimented with other reducing agents beside arsenious oxide, and his results were concordant with the above. He draws three general conclusions:

1—The influence of the anions of mordants is a complex of the most varied influences which involve these points: the reducing action of the mordant itself, the reducing action set up by the thickening-agents as a result of the action of the mordant on steaming, the rate of hydrolysis of the mordant, etc.,

2—Additions which increase the brilliancy of the tone (basic aluminum chloride, arsenious oxide, etc.) exert their action in the most varied ways. They act as reducing agents, as excitants of the reductive properties of thickening-agents, as regulators of the speed of hydrolysis of the mordants, etc.,

3—Sulphocyanides can retard the entry of iron salts into reaction, but if the "iron" is already a constituent of the color, they cannot interfere with its influence upon the results.

Wet-Spinning of Acetate Silk

Fritz Ohl—Kunst-Seide 11, 434 (1929).—A short but weighty paper, pointing out certain advantages enjoyed by fibers produced by wet-spinning—most striking is the additional tensile strength gained; fibers capable of withstanding a tension of 3 g. per denier being not uncommon. Most acetate silk is spun by the dry-spinning process. There exist a large number of patents relating to the spinning-bath, but a survey of them leads one to believe that the points at stake have not, for the most part, been clearly understood. The most suitable baths yet recommended have been composed of a mixture of organic and inorganic substances in solution. Apart from the question of cheapness, the following points have to be considered:

1—The precipitating-bath must allow the greatest possible stretching of the filament, without

2—the coagulating power suffering thereby.

3—The coagulation of the forming filament should not be of such a nature that a shrinking irregularly (crumpling) of the fiber can take place.

4—The components of the bath must bring about a good swelling of the acetate, and be of easy diffusibility.

5—The precipitating-bath must be capable of being easily washed out of the finished fiber.

The spinning-bath, therefore, must obviously contain a fair amount of some substance which is a good solvent for acetate silk (so as to be able to bring about a good degree of swelling). As the composition of most baths is of aqueous nature, the component usually has to be acetone or acetone-alcohol. Such a substance, being of volatile nature, brings about a continuous alteration in the composition of the bath by the continuous, though it may be slight, escape of the acetone. This can be diminished, at least, and the bath ratio made more constant, by further addition of a high-boiling solvent, or of salts which possess a latent solvent power for the acetone. Glycol mono-acetate is one of the best of the just-mentioned higher-boiling solvents, possessing, beside the first requisite, that of being able to hold back the acetone from too rapid volatilization, other properties very favorable for generation of acetate silk. Of the salts used for this purpose, ammonium or calcium thiocyanate are most used, and either alone or in mixture with the glycol mono-acetate; and their favorable influence is due also to their being good precipitating agents. Merely coagulative salts are typified by calcium chloride and sodium acetate. Sulphite liquor is also often added, in the hope that, being of colloid nature, it must, therefore, be of some benefit. But these last-mentioned substances have the disadvantage of being none too easily washed out of the finished fiber. They do impart a better feel to the product, but the same end can be gained by addition of phenols to the bath, and these substances are easily removed by washing.

A further point to be observed is, that the precipitating bath should be neutral or only weakly acid, otherwise partial saponification of the fiber will result, with all the uncomfortable consequences of uneven dyeing. The point is of importance in view of the high concentration at which some of the inorganic salts are present in the bath.

The author makes the surprising, but not incredible, statement, that the quality of the cellulose acetate used is not of such high importance as has been claimed, his experiments showing that grades of acetate designated as poor have given the best fiber by far. The higher grades are indeed best suited for the dry-spinning process. A high content in sulphuric acid, especially in acetate which has been stored, is disadvantageous, as there is sufficient time for development of chemical alteration which shows up plainly in the fiber, and produces the dreaded liability to unevenness in dyeing.

The difficulties encountered in the wet-spinning process are many, but it appears to the author to be quite possible to overcome them in a simple way. He considers the one point to be aimed at, to be: the production of a good fiber from mono-acetate. If this can be done, and he appears hopeful of the prospect, the future of acetate silk would appear to be very promising.

Dull Lustrous Artificial Silk

J. B. Meyer—Kunst-Seide 11, 435 (1929).—This topic has already been discussed, recently, in these columns. The present paper takes up the subject from a rather narrowed, but more searching standpoint.

Comment has been made that the high luster of artificial silk, at first its chief claim to favor, has now become a distinct disadvantage, especially in the higher grades of goods containing or produced from it. The same reversal of public esteem has been noted in the leather, furniture, lacquer, and paper industries, in these for a longer time; and these industries have worked out methods for delustering their products (more properly, for the turning out of non-lustrous products; anything can hardly be said to have been delustered when the formation of a lustrous surface has been avoided from the beginning); methods which the artificial silk industry can study with profit. This luster results from regular reflection of incident light. The reflection is incomplete, to be sure, but proceeds strictly according to the laws of geometrical optics, and produces reflected images, though, of course, not at all to the extent that even a poor mirror would. Non-lustrous, better matt-lustrous, goods possess a surface in which the points of reflection are not in regular order, so that the incident rays of light are reflected in the most irregular way in reference to the general plane of the surface. The reflection may be strong, but is entirely irregular in nature.

Courtaulds' patent, involving the emulsifying of a high-boiling petroleum or of soft paraffin in viscose, was the first patent of this sort to attract attention. A considerable number of substances has since been proposed, which should presumably bring about the same result—the diminution of luster through irregular reflection of light by the dispersed droplets of added material lying distributed throughout the viscose fiber, and so, of course, along and under its surface as well as in the interior. Some of the substances proposed are of little value; Carnauba wax, for example, so used, does impart a desirable

semi-matte luster to the fiber, but in woven material, where any alteration in appearance can be easily observed, it is found that a gentle rubbing of the material increases the luster at once, and considerably, the wax being easily made coherent and so presenting a continuous surface by slight pressure and friction. As to waterproofing properties acquired by fibers so "impregnated" with water-repellent admixtures—they are simply not waterproofed, for the most part. Application of water wets the portion of the surface which consists of the artificial silk substance, and does not wet the droplets of fatty material where they lie upon or in the surface. As the surface of the fiber is mostly cellulose acetate, the fiber is mostly wetted. The emulsification method is not of very much promise in some ways. Lustrous artificial silk, too, it may be remembered, does not tend to become soiled easily by contact with dust; such matte-surfaced material as has been discussed will take up dust to an appalling extent, owing to its uneven surface and presence of oily or soft, waxy particles in that surface.

Colorimetric Determination of Aniline in Atmosphere

Minaeff, Sswetljakoff, and Froloff—Zeits. f. Farben-Ind. 20, 241 (1929).—The danger, to workmen, of aniline vapors in a workroom are well known, and in dyeing aniline black there may be serious quantities of the base in the atmosphere; in addition to the free base, it is quite possible that the aniline hydrochloride with which the goods have been padded may work off as fine dust into the air, while the goods are being dried and mechanically transported to the next stage of working-up. The highest amount of aniline consistent with health, which can be present in the air, for working periods of 6 hours, is 0.15-0.20 mg. per liter (Lehmann).

The method of determination taken up in this paper depends, of course, first of all upon the scrubbing-out of the aniline-content of the air by passing a certain volume of the air in question through an absorbent medium: 10% sulphuric acid. The authors employed Dreschsel wash-bottles, "baffled" with wads of absorbent cotton saturated with the dilute acid in order to promote absorption. This cotton wadding, of course, retains the liquid to such an extent that very careful washing is necessary in order to lose none of the aniline sulphate formed; so that the solution to be analyzed is very dilute, and is at least 200-250 cc. in volume. The volume of the air drawn through has, of course, to be measured, e.g., by using a common reversing-aspirator. The determination of the aniline has to be carried out colorimetrically, of course, with much dilution and in small quantities. The method of titration with standard nitrite is not feasible, because of the minute amount of aniline present, nor is the eudiometric method; that of decomposing the diazo-salt of the aniline by heating the solution and collecting and measuring the nitrogen which is evolved. The gravimetric method, by addition of excess of bromine water and collecting and weighing the tribromaniline formed, is open to the same objection—too little material with which to work. All these methods give good results when sufficient amounts of aniline are involved. The colorimetric method should give maximum sensitiveness and exactness, with requirement of minimal amounts of aniline and a high dilution, as well as a simple method of working.

Of the various color reactions possible with aniline, that depending upon the formation of a mono-azo dyestuff appears to be the best. The passive component of the coupling should be a substance which would be in itself colorless, should couple readily, and should form a product perfectly soluble under the necessary conditions. Of the various compounds first thought of as eligible, Schaeffer, Gamma, R. Chromotrope, and H salts, the latter was chosen. When coupled with diazotized aniline, it gives a dyestuff known as Fast Acid Fuchsine B, of intense color, and of a bluish-red shade, each of which points is in its favor as to recognizability. The color produced is plainly visible at a concentration of 0.1 mg. per liter.

The aniline sulphate solution, prepared by drawing a given volume of air to be tested through the 10% sulphuric acid, is neutralized or nearly so (preferably with caustic) and the solution slightly acidified, if not left so in the neutralization, is treated cold, with a slight excess of sodium nitrite solution, and left standing, cold, for ½-¾ hour. The excess of nitrite and the standing are necessary for complete diazotization, on account of the minute amount of aniline present. The solution is then made slightly alkaline with bicarbonate, and H-acid added in slight excess. The coupling is complete in 10-15 minutes, and the colored solution is evaluated either by comparison with a standard solution of the pure dyestuff in water, or by estimation against solutions prepared by coupling H-acid to standard solutions of aniline hydrochloride, as desired. The amounts of nitrite, H-acid, etc., properly used are easily estimated by a few trials.

The authors worked with an excellent colorimeter of new design (Bock-Benedikt). Comparisons showed results to correspond within 1%. It is not necessary to aspirate large quantities of air in order to obtain the solution to be tested, although 30-50 liters can be drawn through the wash-bottles in a comparatively short time. In some cases, merely shaking up the proper quantity of the dilute acid in a 2-3 liter flash which has been standing open in the room, and so containing that volume of test-air, would be sufficient, for the method is very delicate indeed.

Color and Luster Dyeing of Acetate Silk

H. Brandenburger—Kunst-Seide 11, 425 (1929).—A good paper upon the above two topics, involving discussion of the Ostwald and of the newer Klughardt theories. Five illustrations (two of them graphs) are given.

Dyeing of Acetate Silk

H. Brandenburger—Kunst-Seide 11, 98 (1929).—A lengthy general article, illustrated with nineteen excellent photo-micrographs, two graphs, and four tables. It is not of a practical, but of historical and discussive nature.

Molecular Structure of Artificial Silk

Adolf Rosenzweig—Kunst-Seide 11, 5 (1929).—An hypothesis advanced by some physicists assumes that the "crystallites" of artificial silk lie, in the fiber, at a variable angle to each other, i.e., are more or less irregularly disposed in the body of the fiber, while in the natural fiber, as that of cotton, they are essentially arranged in practically a parallel position, as concerning their longitudinal axis. This difference in position, accordingly, is held by them to be the cause of the difference in tensile strength which exists between a natural and an artificial fiber, in favor of the former. This hypothesis is constructed upon the results of Roentgenographic study—but is unfortunately contradicted by the following facts:

1—Were such a structure actually existent, the diameter of the artificial fiber would be greater than that of cotton of the same titer and twist, but it is essentially less.

2—If the irregular arrangement of the crystallites were the cause of the unsatisfactory tensile strength, the stretched fiber would be of greater strength than the unstretched, since the stretching would tend to arrange the crystallites in a more longitudinal direction. But this is not the case.

The author considers that the crystallites are to be considered as elongated structures, which are at first circular, but which become later somewhat hexagonal in cross-section and are always arranged in a longitudinal position relative to the direction of the fiber. In cotton they lie closely pressed to one another; in artificial fibers they are more or less separated by air-cells. He draws an analogy from the difference between green and dry wood, and the difference in properties between the two states. He holds that the greater porosity (presence of air-cells) of the artificial fiber imparts to it much greater sensitivity to fluctuations in atmospheric moisture than is possessed by, e.g., cotton, and consequently, the fiber being worked up in an atmosphere artificially charged with moisture (humidified), the artificial fibers, loaded, so to say, with moisture, naturally display less resistance to the mechanical attack of friction and tension, being in a kind of unnaturally spongy condition to start with, and this condition aggravated by the inception of swelling under the influence of the water vapor absorbed. According to his view, if the crystallites of artificial fibers are really more or less separated by air-filled interspaces, this would explain:

1—The lesser diameter for the same titer,

2—The fact that in poorer grades the crystallites would be separated by greater air-spaces,

3—The fact that poor grades are more hygroscopic than the better grades,

4—The existence of larger air-spaces in stretched artificial fibers, and as a result, a lower quality.

All these points, he considers, are confirmed by the actual conditions.

The author points out that stretching the fiber is not of benefit, as usually considered, but that it is an actual detriment to the quality of the fiber. He has carried out a large number of tests upon all sorts of material, and concludes that:

1—The quality of the fiber is inversely proportional to its hydroscopicity,

2—The quality is independent of fineness of fiber, degree of twist, titer, or even chemical character,

3—Now and then, among good fibers, one poor one occurs, and in this case it is of no use to consider the average quality, for it is not the 99 good strands, but the one poor one, which breaks in the working up, and costs so much time and trouble to take up. The true criterion of quality is afforded by the loom, not by the dynamometer.

Improvement in quality must take place through a careful study of the factors of pressure, time, and temperature in the synthesis of the fiber. This necessary study has not yet been given to the problem.

Dyeing of Wool with Vat Colors

German Patent No. 438,224—*I. G. Farben-Ind. A.-G.*—The process is intended for mechanical dyeing. After the goods are dyed with the leuco-compound and the liquor forced out, the oxidation of the leuco-dyestuff is brought about by forcing through the goods a suitably dilute solution of hydrogen peroxide. The process may be carried out by dyeing to the desired depth in successive dyeings, each being developed as mentioned. In such cases, the goods do not, of course, need to be unpacked and oxidized in air. This is the principal advantage of the method.

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POSITION WANTED

Dyestuff Salesman with many years of Sales and Laboratory experience is desirous of a suitable position with Manufacturing concern. Advertiser has an extensive personal connection in various States and can give first-class references. Reply to Classified Box No. 608, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

WANTED—KLAUDER WELDON TYPE SKEIN DYEING MACHINES

Especially interested in the smaller sizes, both hoist and non-hoist. Give complete details and condition. Address Classified Box No. 625, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.

POSITION WANTED

Textile Chemist with eight years' experience as assistant to purchasing agent; also, familiar with dry cleaning industry. Desires position at once. Excellent references. Married. Address Classified Box No. 626, American Dyestuff Reporter, 440 Fourth Avenue, New York, N. Y.